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ABSTRACT

This instructional information packet had been prepared to help teachers plan lessons and activities related to natural resources. It contains posters, activity sheets, teacher guides, student pages, background and study sheets, video and reading lists, free video offers, and sources for more information. (JRH)

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ED 388 511

Teacher's Helper Packet

A Study of the Earth: Everything Comes From Our Natural Resources

Mineral Information Institute

1994

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Primary & Elementary Grades

Lessons and Activities of Discovery

Teacher Guide
and
Student Pages
48 pages

• Everything Is Made of Something •

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Teacher Guides
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• • • • • • • • • • • • • • • • •

A Study of the Earth

Everything Comes From Our Natural Resources

Let's appreciate the Earth and our place on it.

- **Where in the World Do Our Natural Resources Really Come From**
- **Is It Plant, Animal, or Mineral**
- **How Many Countries Does It Take to Make A Light Bulb**
- **Coloring Pages and Word Searches**
- **Legends and Lost Gold Mines**
- **Identifying Organics & Inorganics**
- **What Are Clothes Made Of**
- **If You Were King of the Land**
- **Discover The Resources That Made Your Classroom**

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INFORMATION
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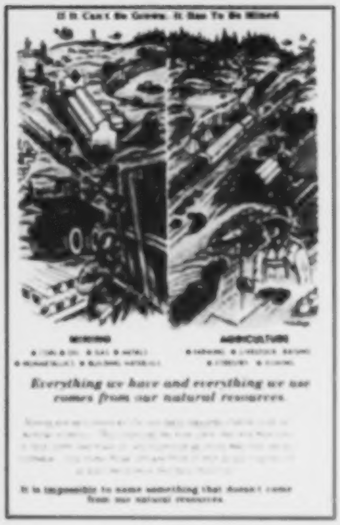
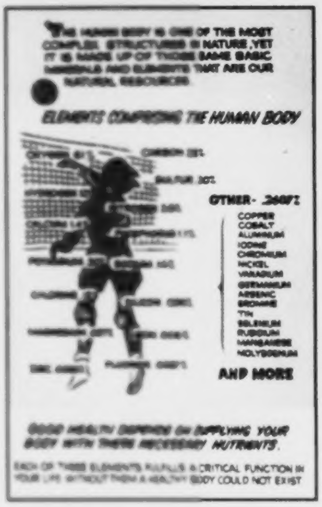

If It Can't Be Grown, It Has To Be Mined
MINING
AGRICULTURE
Everything we have and everything we use comes from our natural resources.
It is impossible to name something that doesn't come from our natural resources.

Posters 11" x 17"

FROM THE EARTH . . . A BETTER LIFE
Land Use In The
Reclamation Is A Way Of Life


THE HUMAN BODY IS ONE OF THE MOST COMPLEX STRUCTURES IN NATURE, YET IT IS MADE UP OF THOSE SAME BASIC MINERALS AND ELEMENTS THAT ARE OUR NATURAL RESOURCES
ELEMENTS COMPRISING THE HUMAN BODY
OTHER - .260%
COPPER
COBALT
ALUMINUM
IODINE
CHROMIUM
NICKEL
VANADIUM
GERMANIUM
ARSENIC
BROMINE
TIN
SELENIUM
RUBIDIUM
MANGANESE
MOLYBDENUM
AND MORE
GOOD HEALTH DEPENDS ON SUPPLYING YOUR BODY WITH THESE NECESSARY NUTRIENTS.
EACH OF THESE ELEMENTS FULFILLS A CRITICAL FUNCTION IN YOUR LIFE. WITHOUT THEM A HEALTHY BODY COULD NOT EXIST

MINING AT PLAY.

Look Around ...

Posters 23" x 35"

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Washington, D.C. 20036

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Mineral Information Institute
475 17th Street, Suite 510
Denver, Colorado 80202
(303) 297-3226 Fax (303) 295-6463

SME Education Foundation
Box 625002
Littleton, CO 80162-5002

NATURALLY YOURS

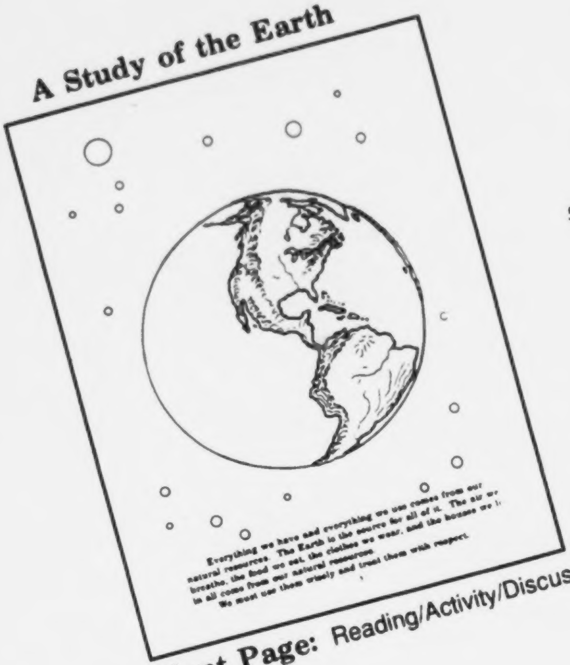
An Appreciation of the Earth and All It Provides

Most people pass their days without thinking about the role natural resources play in their lives. They know where to buy the things they want but seldom consider the origins of these items.

They think food comes from a grocery store . . . electricity from a wall socket, clothes from a store, cars from a dealer, appliances from a department store . . . and so on. If we do think of how these things are created, many of us probably begin with farms, factories and power stations. But without minerals and mining, we could not till our soil, build our machines, heat and cool our homes, transport our goods or maintain our society beyond the most primitive level

Everything comes from something, and that "something" is our natural resources..

> **"The vast loneliness up here is awe-inspiring, and it makes you realize just what you have back there on Earth. The Earth from here (the Apollo-8 spacecraft) is a grand oasis in the big vastness of space."**
>
> ***Astronaut James A. Lovell, Jr.***



A Study of the Earth

Everything we have and everything we use comes from our natural resources. The Earth is the source for all of it. The air we breathe, the food we eat, the clothes we wear, and the houses we l in all come from our natural resources. We must use them wisely and treat them with respect.

Student Page: Reading/Activity/Discussion

Dig A Little Deeper

Is it possible for the Earth to run out of natural resources? Is it probable?

AT HOME Discuss with families what would life be like if we didn't use natural resources. Discuss why we need to treat the Earth with respect and use our natural resources wisely.

If You Can See It, Touch It, Taste It, Smell It, Or Hear It,
It's A Natural Resource.

Exploring The Earth

Classroom Experience

- Using a *globe*, have the students identify which parts are solid, liquid, and gas.
- Have the students discuss where on Earth they are and where they have been on vacations.
- Demonstrate how day and night work by turning off the lights and using light from a window to illuminate the globe.
- More than 70% of the surface of the Earth is covered with water. Describe how snow and rain get to the rivers and eventually the ocean, and back again to land.

Elements Comprising the Earth's Crust

Oxygen	46.6%
Silicon	27.7%
Aluminum	8.1%
Iron	5.0%
Calcium	3.6%
Sodium	2.8%
Potassium	2.6%
Magnesium	2.1%
Other	1.5%

Visualization

If visualization is difficult for the students, try this: Show a photograph of you or one of your students. Show photo of the entrance to your school that students are familiar with, stating that you (student) are inside the building. Show aerial photo of school (administration office should have one), stating that this is how the school looks from up in the sky. Then show photo or sketch of Earth in space, pointing out where your school (town) is located.

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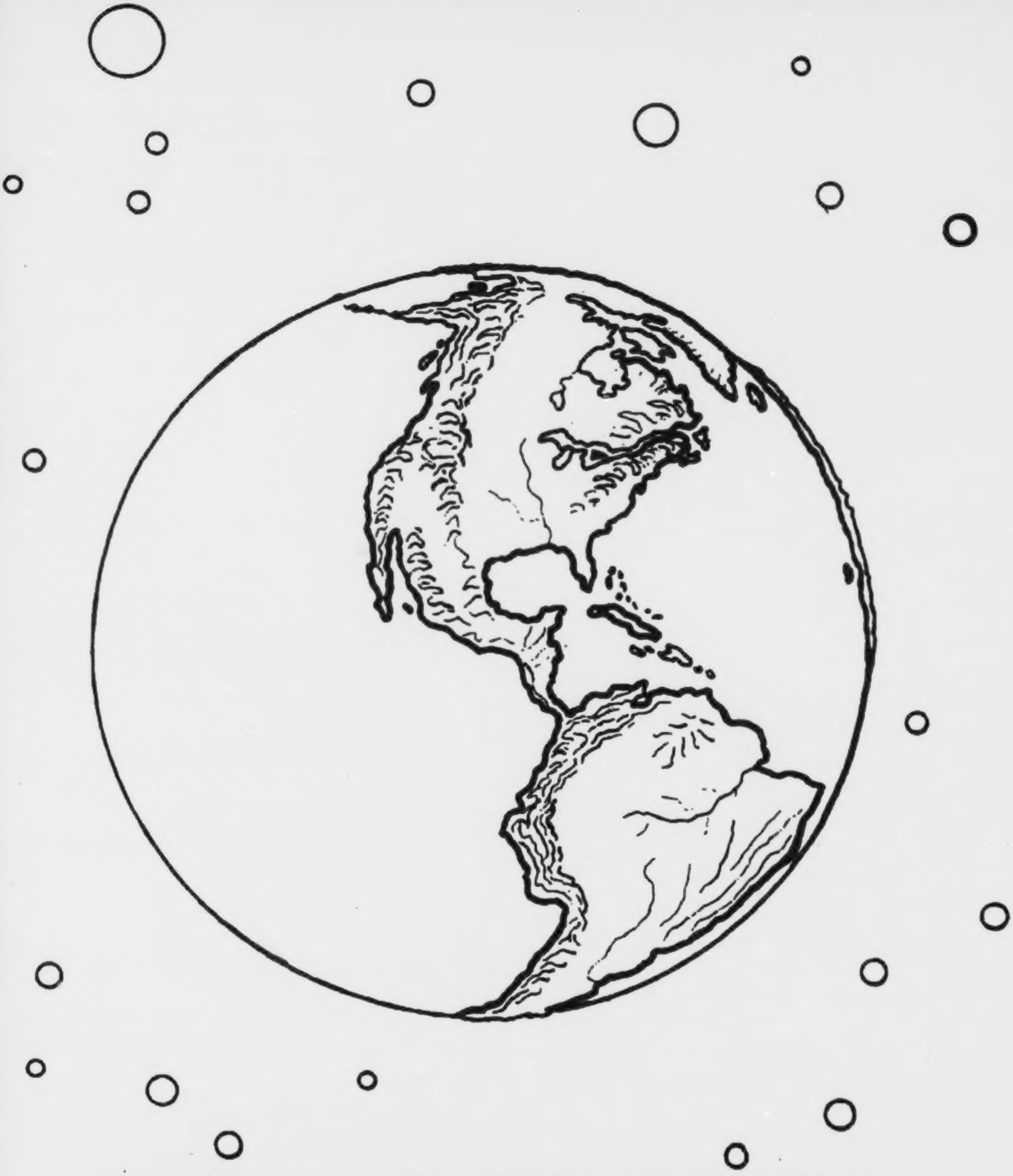
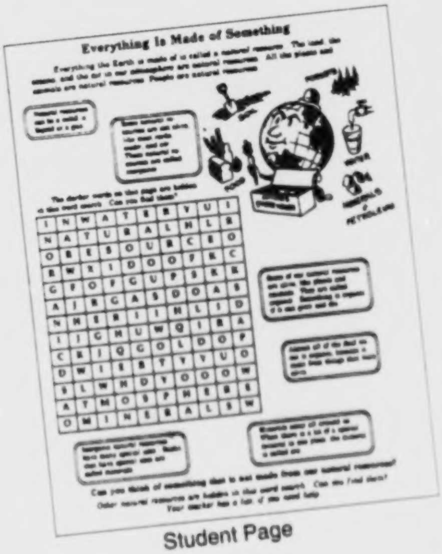


Everything we have and everything we use comes from our natural resources. The Earth is the source for all of it. The air we breathe, the food we eat, the clothes we wear, and the houses we live in all come from our natural resources.

We must use them wisely and treat them with respect.

NATURAL RESOURCES MATTER

Objective: To develop the concept that everything is made from a natural resource.



Student Page

A Few Facts

Everything is either plant, animal or mineral. There is no exception. Each natural resource can be classified according to its state of matter – solid, liquid or gas. Each can also be divided into organic and inorganic matter.

Organic matter is (or once was) alive; it can live and die. Matter that can be *derived* from something that was alive is also organic, such as coal and some types of limestone. If something contains carbon, it's organic.

Inorganic matter, such as rocks, water and air, are not alive.

- Organic matter needs inorganic matter to live.
- Inorganics can exist without organics.

All jobs are related to natural resources – some more directly than others. All jobs are involved in upgrading (manufacturing) or using (service industry) natural resources. Only a few jobs are involved in actually developing the natural resources upon which everything else is dependent. They are:

Farmers, ranchers and fishermen: work to make the food we need from organic natural resources.

Forestry workers: work in the forest to help us use the wood from the trees.

Miners: dig ore out of the ground to help us make things such as steel, glass, concrete, petroleum, electricity, etc.

Read More About It!

Check out these children's books for your class:

- *Around the World in Eighty Days* by Jules Verne (many editions available)
- *Coal: How It is Found & Used* by Michael Hansen; Enslow Publications
- *From Gold to Money, From Graphite to Pencil, From Sea to Salt* and *From Swamp to Coal,* (four books) by Ali Mitgutsch; Carolrhoda Books
- *The Magic Schoolbus Inside the Earth,* by Joanna Cole; Scholastic
- *Rocks Tell Stories,* by Sidney Horenstein; Millbrook Press
- *From Seed to Plant* by Gail Gibbons; Holiday House

Video Deal

Rock Odyssey, 30 minutes. Free preview to media center or film service. For primary grades – rocks and minerals; learning through song with real samples. Call 1-800-523-0118.

Classroom Experience

In order to better understand the composition of the things around us:

Title a piece of paper "Natural Resources." Rule the paper into three wide columns, and label each column with one state of matter.

Divide each column vertically again with a dotted line. Label the columns "organic" and "inorganic."

Brainstorm with the students and come up with a list of items to insert into the chart under the correct classification. Include everything in sight in the classroom and even those things out of sight, such as air.

Absolutely everything that's mentioned can be categorized first as a solid, liquid or gas, and then as organic or inorganic.

Dig A Little Deeper

Is there anything that isn't made from a natural resource? Have groups of students challenge one another to research something that doesn't come from natural resources. (They won't find anything.)

Integrating the Curriculum

1. Explore the various ways to measure the three states of matter.
2. Prepare a list of rock formations that have become geographic symbols of countries or specific parts of countries, such as Gibraltar, Mt. Rushmore, etc.
3. "Colorado Home" was written by prospectors in Leadville, CO, during the winter of 1884. Was it the original "Home on the Range"? Check the words (available from MII), the tune and the dates.
4. Is the "oxygen" used in hospitals like the air we breathe? How is it different? Can oxygen be used up in a contained space?

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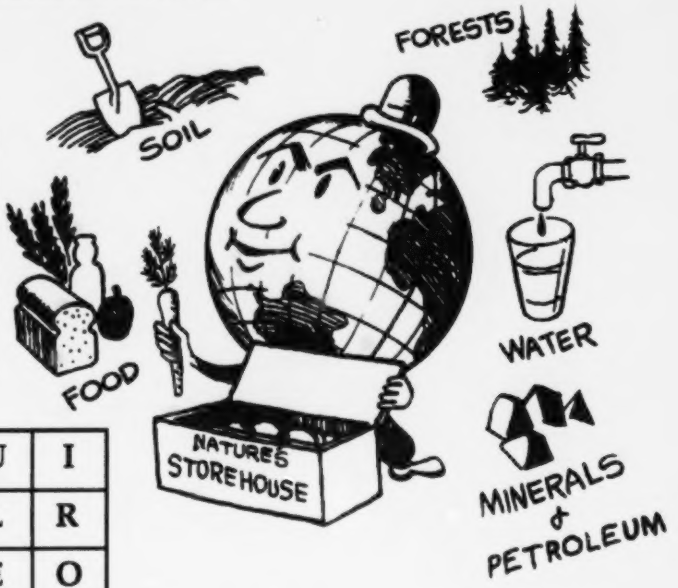
Everything Is Made of Something

Everything the Earth is made of is called a ***natural resource***. The land, the oceans, and the air in our ***atmosphere*** are natural resources. All the plants and animals are natural resources. People are natural resources.

Natural resources can be a **solid**, a **liquid** or a **gas**.

Some natural resources are not alive, like most ***rocks***, ***water***, and ***air***. These natural resources are called ***inorganic***.



The ***darker*** words on this page are hidden in this word search. Can you find them?

I	N	W	A	T	E	R	Y	U	I
N	A	T	U	R	A	L	H	L	R
O	R	E	S	O	U	R	C	E	O
R	W	X	1	D	O	O	F	K	C
G	F	O	F	G	U	P	S	K	K
A	J	R	G	A	S	D	O	A	S
N	H	E	R	I	I	H	L	I	D
I	J	G	H	U	W	Q	I	R	A
C	K	J	Q	G	O	L	D	O	P
D	W	I	E	R	T	Y	Y	U	O
S	L	W	H	D	Y	O	O	O	W
A	T	M	O	S	P	H	E	R	E
O	M	I	N	E	R	A	L	S	W

Some of our natural resources are alive, like plants and animals. They are called ***organic***. Something is organic if it can grow and die.

Almost all of the ***food*** we eat is organic, because it came from things that were alive.

Inorganic natural resources have many special uses. Rocks that have special uses are called ***minerals***.

Minerals occur all around us. When there is a lot of a special mineral in one place, the mineral is called ***ore***.

Can you think of something that is not made from our natural resources?

Other natural resources are hidden in this word search. Can you find them? Your teacher has a list, if you need help.

Everything Is Made of Something

Everything the Earth is made of is called a ***natural resource***. The land, the oceans, and the air in our ***atmosphere*** are natural resources. All the plants and animals are natural resources. People are natural resources.

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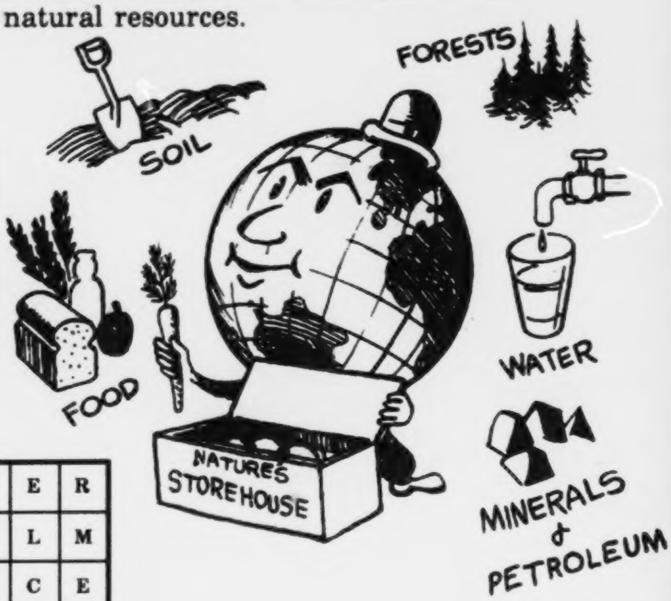

The ***darker*** words on this page are hidden in this word search. Can you find them?

A	I	R	S	T	O	R	E	H	O	U	S	E	E	R
S	N	A	T	U	R	A	L	H	H	O	F	P	L	M
D	O	N	T	W	O	R	R	E	S	O	U	R	C	E
F	R	C	I	M	R	M	E	E	R	O	E	A	A	N
S	G	H	O	E	O	E	U	D	W	K	L	L	H	E
F	A	R	M	T	L	S	D	E	K	E	W	I	I	R
G	N	N	P	A	L	I	P	G	L	F	O	O	D	G
H	I	S	D	L	U	R	P	H	S	O	D	S	T	Y
J	C	W	M	Q	G	O	L	D	E	P	R	W	D	L
J	L	C	I	E	R	C	N	B	U	R	I	T	O	P
K	A	L	N	W	F	K	G	W	A	T	E	R	E	K
F	O	R	E	S	T	S	Q	S	C	E	H	U	I	P
K	C	E	S	D	R	B	S	L	A	R	E	N	I	M
L	A	G	G	R	E	G	A	T	E	W	E	R	T	N
P	O	I	U	U	Y	T	G	R	A	V	E	L	R	E

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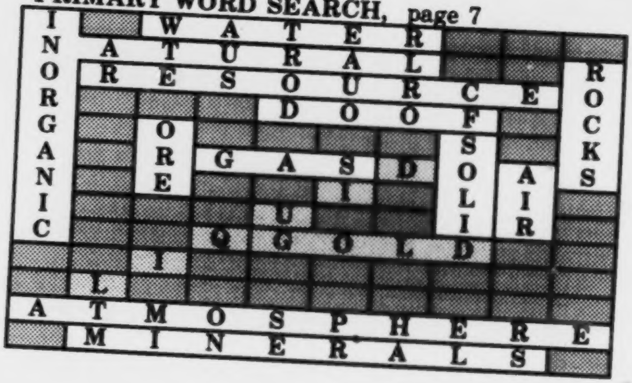
PRIMARY WORD SEARCH, page 7



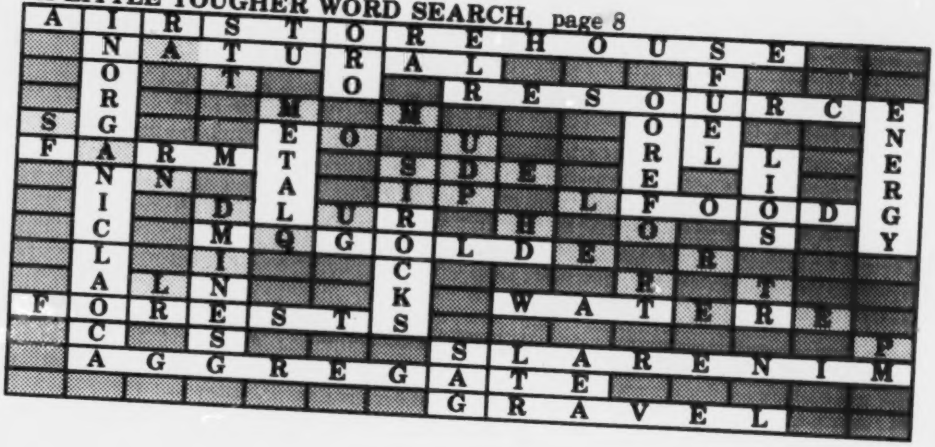
WATER
ATURAL
RESOURCE
DOOF
ORE
GASD
SOLID
AIR
ROCKS
INORGANIC
GOLD
ATMOSPHERE
MINERALS

HIDDEN WORDS

- Natural Resource
- Atmosphere
- Solid
- Liquid
- Gas
- Rocks
- Water
- Air
- Inorganic
- Organic
- Food
- Minerals
- Ore

1 diagonal word, in lighter shade

A LITTLE TOUGHER WORD SEARCH, page 8



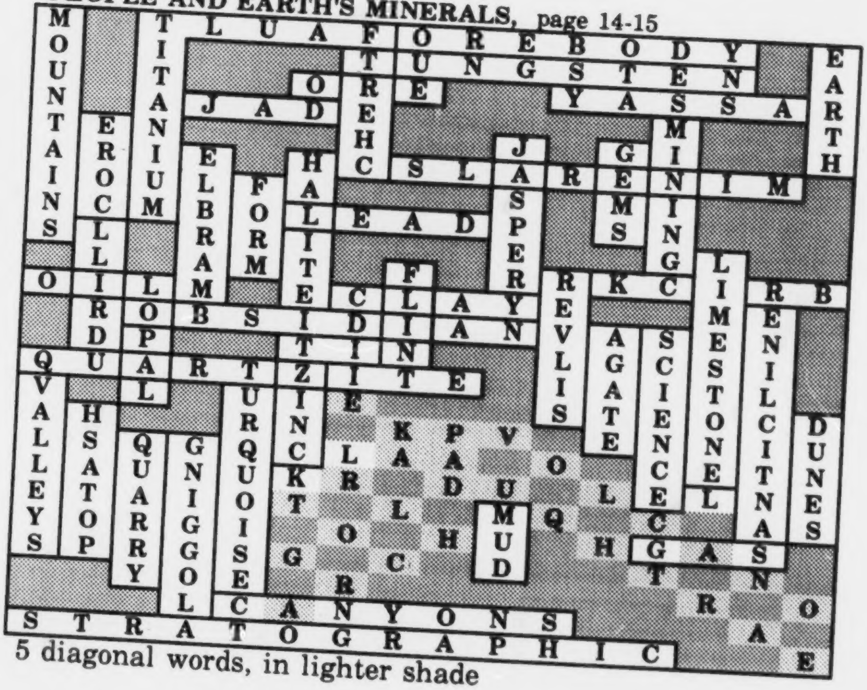
AIRSTOREHOUSE
NATURAL
RESOURCE
ENERGY
INORGANICLAOC
METAL
ORO
FOOD
OIL
FUEL
SOIL
GOLD
ROCKS
WATER
FORESTST
AGGREGATE
SLARENIM
GRAVEL

More Words

- Forests
- Coal
- Aggregate
- Farm
- Oro
- Petroleum
- Oil
- Soil
- Mines
- Gravel
- Metal
- Ranch
- Sand
- Storehouse
- Energy
- Fuel

4 diagonal words, in lighter shade

PEOPLE AND EARTH'S MINERALS, page 14-15



MOUNTAINS
TITANIUM
TLUAFOREBODY
TUNGSTEN
EARTH
ORE
JAD
YASSA
TREHC
SLARENIM
JASPER
GEMS
MINING
EROCLIRDU
ELBRAM
FORM
HALITE
LEAD
LIMESTONE
CLAY
OBSIDIAN
QUARTZITE
REVLIS
AGATE
SCIENCE
ENILCITNA
VALLEYS
HSATOP
QUARRY
GNIGGOL
TURQUOISE
DUNES
MUD
GAS
CANYONS
STRATOGRAPHIC

5 diagonal words, in lighter shade

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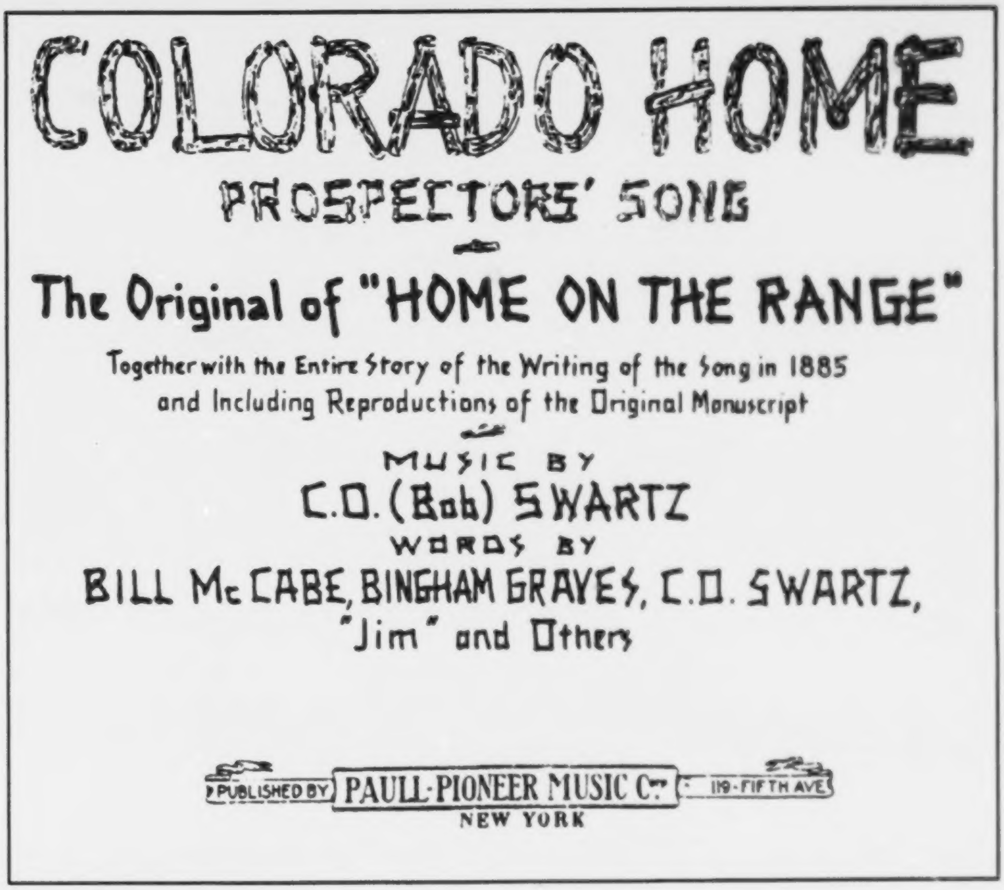


COLORADO HOME
PROSPECTORS' SONG

The Original of "HOME ON THE RANGE"

Together with the Entire Story of the Writing of the Song in 1885
and Including Reproductions of the Original Manuscript

MUSIC BY
C.O. (Bob) SWARTZ
WORDS BY
BILL McCABE, BINGHAM GRAVES, C.O. SWARTZ,
"Jim" and Others

PUBLISHED BY PAULL-PIONEER MUSIC Co. 119-FIFTH AVE
NEW YORK

During the bleak winter of 1884-1885 in the boomtown of Leadville, Colorado, few diversions were at hand to occupy the evenings of those lonely prospectors who preferred to avoid the saloons, gambling halls, and scarlet ladies. But for Crawford O. "Bob" Swartz and his friends, there was music to make.

Bob and Bill McCabe and Bingham Graves and "Jim" (surname probably Fouts) had a fiddle, harmonica, and banjo band, and they would lounge about their shanty, which they called the "Junk Lane Hotel," and play and sing. "I can still see," Bob wistfully wrote years later, and these are his spellings, "the whole gang setting around on soap boxes & on the bed, all trying to make the liens rhyme so they sounded like poetry. Then when they got a verse so it sounded good, I would play the tune & Bill McCabe with the banjo & his nice tennor voice would lead in singing. I can see them all yet."

One of the tunes Bob and friends wrote was titled "Colorado Home," and the first verse began "Oh! Give me a home/ Where the buffalo roam/ And the deer and the antelope play."

Bob jotted the words in the musical notebook he always carried, and in a letter to his parents dated February 15, 1885, he described the writing of the song: "We have originated a new song, music and all, & it's creating quite a stir among the boys all around. I got up the tune and Bill most of the words, but we all had a hand in it. As the cabin was full that night & every body help make it up, if it keeps on going it will become a popular western song."

Soon the Junk Lane Gang broke up and scattered in all directions, Swartz returning to his home in Pennsylvania.

Many years passed, and radio was invented, and from these electronic loudspeakers wafted a hit song titled "Home on the Range." Imagine the surprise of Swartz to hear "his" song on the radio—even though some of the verses were different: What, for instance, had been

Oh, give me a hill
And the ring of the drill,
In the rich silver ore in the ground. . . .

was now

How often at night,
When the heavens are bright
With the light of the glittering stars. . . .

Swartz died on March 12, 1932, convinced that his, and not the other, was the original of "Home On The Range." Concerned that her brother may have written an American classic for which he received neither recognition nor recompense, Swartz's sister, Laura M. Anderson of Parkland, Pennsylvania, wrote to the Paull-Pioneer Music Corporation, publisher of "Home on the Range," inquiring of the song's origin. She included a copy of the 1885 letter written by her brother, citing the lyrics to "Colorado Home."

Kenneth S. Clark of the Paull organization, who had supervised Paull's publishing of "Home On The Range," responded:

> [Writing of "Colorado Home"] was as close to general public recognition as Mr. Swartz came during his lifetime, for he died . . . without having received credit before the world for the part played by himself and his comrades in the creating of what is now the favorite song of many Americans, Including President Franklin D. Roosevelt. . . The story may therefore make us reflect meditatively

> that there must have been many other anonymous authors of our songs of the Far West who passed to the Great Round-Up, as did Mr. Swartz, without receiving the least public recognition of their contributions to our folk literature.

To assuage whatever wrongs may have been perpetrated against Bob Swartz and his friends, Paull-Pioneer in 1933 published sheet music of "Colorado Home," with lyrics as written in Leadville. The sheet also included the original jottings from Bob's notebook, a copy of the letter to his parents, an affidavit from his sister, a photo of Swartz and of Leadville including the Junk Lane Hotel, and, most importantly, the assertion in bold print that "Colorado Home" was: "The Original of 'Home on the Range' Together with the Entire Story of the Writing of the Song in 1885." Added was a sympathetic explanation of the whole affair by Mr. Clark of the Paull organization:

> [The] spread of the song (Home on the Range) in the Far West was typical of what are commonly known as fold songs—songs of no known authorship which have become songs of the people. . . . It is probable that the [Junk Lane crowd] performed it for their friends and associates, and thus it came to be generally sung without anyone's knowing who had written it. That is the case with many of most folk songs. . .

Thus it was recognized by the publisher of "Home on the Range" that the Junk Lane musicians were essentially the song's composers.

COLORADO HOME

PROSPECTORS' SONG

The Original of "Home On The Range"

Oh, give me a home where the buffalo roam,
And the deer and the antelope play;
Where seldom is heard a discouraging word,
And the sky is not cloudy all day.

Oh, give me the hill and the ring of the drill,
In the rich silver ore in the ground;
And give me the gulch, where the miners can sluice,
And the bright yellow gold can be found.

Oh give me the gleam of the swift mountain stream,
And the place where no hurricanes blow;
And give me the park with the prairie dog bark,
And the mountains all covered with snow.

Oh, give me the mines where the prospector finds
The gold in its own native land;
With the hot springs below, where the sick people go,
And camp on the banks of the Grand.

Oh, show me the camp where the prospectors tramp,
And business is always alive;
Where dance halls come first and fare banks burst,
And every saloon is a dive.

Chorus

A home, a home, Where the deer and the antelope play;
Where seldom is heard a discouraging word,
And the sky is not cloudy all day.

And there the matter rested until 1935, when New York attorney Samuel Moanfeldt was retained to investigate the origins of "Home on the Range" in conjunction with a $500,000 copyright infringement lawsuit brought by William and Mary Goodwin of Tempe, Arizona. They contended that their "An Arizona Home" was the parent song of "Home on the Range."

Moanfeldt performed a thorough investigation which took him to several states and cities, including Leadville and other Colorado points, interviewing survivors and acquaintances of Swartz, Graves, Fouts, and McCabe. Moanfeldt's conclusions were (a) that the Goodwins had no case; (b) that the growing number of persons asserting authorship of "Home on the Range" was remarkable; (c) that the original song was probably much older than 1885 when Swartz claimed to have written it; (d) that the Junk Lane Hotel boys may indeed have written five stanzas not in the original but instead which suited their own prospecting circumstances and their Colorado environment.

Moanfeldt and subsequent sources ascribe "Home on the Range" not to Leadville, Colorado, but instead to Smith Center, Kansas (indeed, in 1947 it became the Kansas state song). The melody is thought to have been written by carpenter and musician Daniel E. Kelly, and the words by itinerant alcoholic physician Brewster M. Higley, and first published in a December 1873 issue of the *Smith County Pioneer* under the title "Oh, Give Me a Home Where the Buffalo Roam."

Sources: Clark Secrest, © Colorado Heritage magazine, Colorado Historical Society, and Mary B. Cassidy, Leadville historian extraordinaire.

CLOTHING MATTERS

Objective: To discover the natural resources that create our clothing.

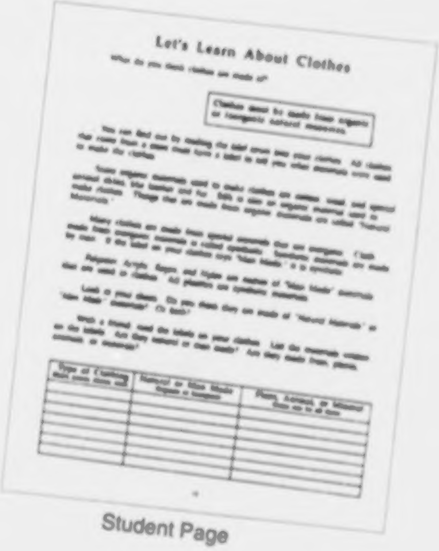
A Few Facts

Virtually all synthetic fabrics are made from petro-chemicals.

Some of the rubber on shoes is natural rubber with chemical additives. However, most tennis shoe rubber is synthetic. Shoelaces can be composed of both natural and man-made materials.

Almost all modern buttons are made of plastic. Thread and labels are generally cotton, polyester or blends of the two.

Recent years have seen a renewal of interest in clothing made of natural fibers, but household goods are still made of minerals, metals and synthetic materials.



Let's Learn About Clothes

Student Page

Classroom Experience

Research the origins of the following clothing fibers:

Cotton, silk, rayon, nylon, polyester or acrylic fibers, ramie and wool.

How are these different materials colored and made into clothing?

Discover what your clothes are made of.

Ask each student to choose a partner, and taking turns, read the labels in one another's clothing. Students can then make a chart listing the different fibers they are wearing and the sources of those fibers.

Discuss the purpose of clothing labels.

Which materials are man-made and which are natural?

What properties of any specific fiber make it attractive for clothing use?

Analyze the "content" and "care" information. Determine the characteristics of different clothing materials. Why can some be washed in hot water, others only in cold? Why can't some be put in a clothes dryer or ironed? What about bleach?

Dig A Little Deeper

- Make life-size replicas of the clothing worn at different times in the history of the country; Pilgrims and Indians, the Civil War, World War II; and label each piece of clothing and the origin of its fiber.
- Write an advertisement for a new line of clothing using only man-made (synthetic) materials.
- Levi's were "invented" for miners during the California Gold Rush. What other special clothes were necessary if you lived 100 years ago?

Integrating the Curriculum

1. How much does a wool sweater weigh? In about the same style and size, how much does an acrylic sweater weigh? Do they use the same amount of space when folded?
2. What is the process that makes raincoats waterproof and how does it work?
3. What is the origin of the word "denim?" (The word is of French origin; it described fabric from Nimes, or "de Nimes.") Why do we call the denim pants "blue jeans?"
4. Have students search their homes for other labels such as these: nutrition & health – cereal boxes and vitamins; safety – electric hair dryer; operating instructions – appliances.

Read More About It!

Check out these children's books for your class:

- *Cotton* by Millicent Selsam; Morrow Junior Books
- *Adventures with Atoms and Molecules: Chemistry Experiments for Young People Gr. 4-9*; Enslow Publishers
- *The Keeping Quilt* by Patricia Polacco; Simon & Schuster
- *The Rag Coat* by Lauren Mills; Little Brown
- *18th Century Clothing* and *19th Century Clothing* by Bobbie Kalman; Crabtree Publishing
- *Cotton in Your T-Shirt* by Aline Riquier; Young Discovery Library

Video Deal

Out of The Rock, 30 minutes. A broad look at the importance of minerals and mining in the past and present and technological challenges of the future. Return postage required. Write: U.S. Bureau of Mines; A/V Library; Cochrans Mill Rd.; P.O. Box 18070; Pittsburgh, PA 1236. Phone: 412-892-6845; Fax: 412-892-4292.

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Let's Learn About Clothes

What do you think clothes are made of?

Clothes must be made from organic or inorganic natural resources.

You can find out by reading the *label* sewn into your clothes. All clothes that come from a store must have a label to tell you what materials were used to make the clothes.

Some organic materials used to make clothes are **cotton**, **wool**, and special **animal skins**, like leather and fur. **Silk** is also an organic material used to make clothes. Things that are made from organic materials are called "Natural Materials."

Many clothes are made from special minerals that are inorganic. Cloth made from inorganic minerals is called **synthetic**. Synthetic materials are made by man. If the label on your clothes says "Man Made," it is synthetic.

Polyester, Acrylic, Rayon, and Nylon are names of "Man Made" materials that are used in clothes. All **plastics** are synthetic materials.

Look at your shoes. Do you think they are made of *"Natural Materials"* or *"Man Made"* materials? Or both?

With a friend, read the labels on your clothes. List the materials written on the labels. Are they natural or man made? Are they made from, plants, animals, or minerals?

Type of Clothing **Shirt, pants, shoes, coat.**	**Natural or Man Made** **Organic or Inorganic**	**Plant, Animal, or Mineral** **Some can be all three**

PEOPLE AND EARTH'S MINERALS

Word Search Story

Ancient people used **minerals** that came from the **Earth**. They used **chert**, **flint**, **jasper**, **obsidian** and **quartzite** for tools and weapons which they shaped by using deer antlers (which are shed every year) or other hard-pointed sticks or rocks.

Ancient people used **clay** to make pots for cooking and jars to hold water or store food. Some minerals and **gems**, such as **agate**, **jade**, **opal**, and **turquoise**, were prized possessions and were often used for trading and bartering.

Ancient people learned how to mix soil and water to make **mud**. Straw and grass were added to the mud to make it stronger. This mixture was then formed into brick-like shapes and dried. The bricks, called adobe, could be stacked and stuck together with more mud. Today, bricks are made of clay.

Even ancient people experienced the violent actions of **earthquake**s or **volcano**es that change Earth's **form**. The land we live on has many forms and is always changing. In some places there are **mountains**. In other places there are **canyons** and **valleys**. Each type of land form has a name. In the San Luis Valley of Colorado you will find sand **dunes**. The wind action keeps the dunes in one area but their shapes are constantly changing. In Utah there is a land form called Arches National Monument. The wind, rain, and snow have actually worn huge holes all the way through **limestone** outcrops. Forms that look like rock bridges are called **arch**es. There are many odd shapes formed by the erosion of wind and water. Some even look like people.

Modern people have an easier way of life than the ancient people because of advances in **science** and technology. All of the products we use today also come from the Earth. The raw materials used to make the products we need have to be mined.

Mining for minerals is done in many ways. Some minerals are found near the surface of the Earth. They can be mined by the open pit or strip mining method. Minerals that are hidden deep in the Earth are extracted by digging a deep shaft straight down. Horizontal drifts are mined off certain levels of the shaft. All mining depends on where economic concentrations of minerals (**ore**) are found.

Note to teacher: There are 48 words in bold-face. These words can be found in the Word Search puzzle on next page.

When economic amounts of a mineral are found it is called an **ore body**. As an example, **halite** (salt) is found in almost pure form in the state of Kansas. Halite is usually mined underground by the room-and-pillar mining method. This method is also used to mine trona and **potash**. Potash is used as a fertilizer. **Marble** (the metamorphic form of limestone) is mined by the **quarry** method. It is taken out of the ground in big blocks and is used for buildings, flooring, and for art works such as statues.

An ore body may contain a combination of metals such as **tin**, **titanium**, **lead**, **zinc**, **tungsten**, **gold**, and **silver**. When more than one mineral is found in an ore body a scientist (metallurgist) has to decide which processes will be needed to recover each mineral. Processing multiple metals/minerals can be very expensive.

To determine the size and value of an ore body, geologists drill holes in the Earth. The drill they use is called a core drill. The entire core is brought to the surface where the geologist inspects its mineral content. Geologists call this core "**drill core**." The **logging** (recording) of the drill core is very important. The geologist records the depth at which the core was taken and the amount of mineral present. **Assay**s by a chemist are made to determine the quantity and quality of the mineral or metals present. Sometimes many holes have to be drilled to show the outline of the ore body. After the drilling data is plotted on a map the geologist can determine whether the ore body is large enough to mine at a profit.

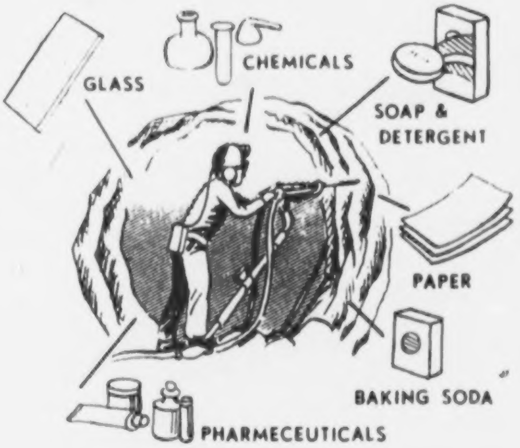
Oil and **gas** are also mined, but in a different way than metals and minerals. Holes (called wells) are drilled into the ground until they hit a rocks containing economic amounts of oil or gas. Oil and gas fill the tiny spaces between the grains of porous rocks, usually sandstone. Oil and gas move upward in thes porous rocks until they are stopped (trapped) by nonporous rocks, usually a shale called caprock. There are three types of **trap**s. An upward bulge of rock layers is called an **anticline** trap. Where caprock is moved by faulting on top of oil and gas-bearing beds, the trap is called a **fault** trap The hardest place to find oil is in a **stratigraphic** trap. A stratigraphic trap is where a body of sandstone (like a sandbar or river channel) is enclosed by nonporous rock.

Formations containing oil and gas, coal, as well as minerals and metals may lie under mountains, deserts, marshes, or seas. They may be two or three miles below the surface. Some are deeper.

Natural resources are a gift to Earth's people. We should use and conserve them wisely. The quest for a better lifestyle has brought untold benefits to the human beings who inhabit our Earth—none of which would exist but for the ingenuity and thought processes of the human mind.

To investigate more about our Earth and its natural resources, just for fun—try your school or local library........which book will you use for starters?

The bold-face words used in the lesson you have read are shown to the right. Have fun finding them in the word search below!
(Note: there are only 5 diagonal words.)



TRONA MINING and USES
Mineral Information Institute © 1985

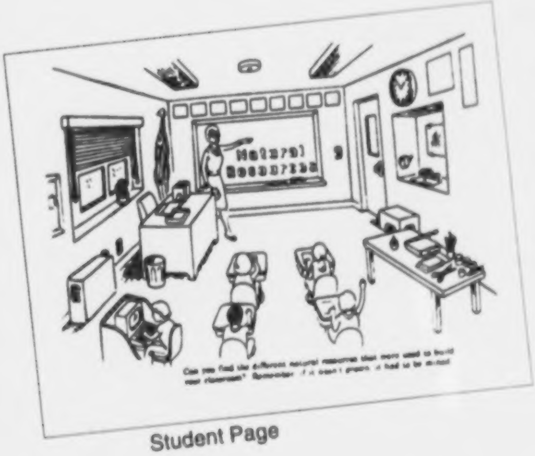
The world's largest deposit of trona is found in Wyoming's Green River Basin. This deposit produces about 95% of the United States supply of natural soda ash.

Agate
Anticline
Arch
Assay
Brick
Canyons
Chert
Clay
Drill Core
Dunes
Earth
Earthquake
Fault
Flint
Form
Gas
Gems
Gold
Halite
Jade
Jasper
Lead
Limestone
Logging
Marble
Minerals
Mining
Mountains
Mud
Obsidian
Oil
Opal
Ore
Orebody
Potash
Quarry
Quartzite
Science
Silver
Stratigraphic
Tin
Titanium
Tungesten
Turquoise
Trap
Valleys
Volcano
Zinc

M	Q	T	L	U	A	F	O	R	E	B	O	D	Y	T	E
O	Y	I	U	G	K	T	U	N	G	S	T	E	N	R	A
U	T	T	G	R	O	R	E	G	O	Y	A	S	S	A	R
N	X	A	J	A	D	E	R	H	T	U	O	M	T	O	T
T	E	N	Y	U	N	H	E	A	J	H	G	I	X	Y	H
A	R	I	E	L	H	C	S	L	A	R	E	N	I	M	B
I	O	U	L	F	A	T	H	E	S	I	M	I	N	A	G
N	C	M	B	O	L	E	A	D	P	E	S	N	T	A	C
S	L	U	R	R	I	O	T	P	E	H	E	G	L	B	E
P	L	E	A	M	T	X	F	W	R	R	K	C	I	R	B
O	I	L	M	X	E	C	L	A	Y	E	L	A	M	E	R
R	R	O	B	S	I	D	I	A	N	V	A	S	E	N	U
K	D	P	E	I	T	I	N	L	O	L	G	C	S	I	O
Q	U	A	R	T	Z	I	T	E	T	I	A	I	T	L	Y
V	O	L	Q	U	I	E	H	A	E	S	T	E	O	C	D
A	H	I	U	R	N	X	K	P	V	M	E	N	N	I	U
L	S	Q	G	Q	C	L	A	A	L	O	G	C	E	T	N
L	A	U	N	U	K	R	T	D	U	X	L	E	L	N	E
E	T	A	I	O	T	W	L	P	M	Q	E	C	K	A	S
Y	O	R	G	I	K	O	J	H	U	U	H	G	A	S	D
S	P	R	G	S	G	W	C	N	D	A	W	T	L	N	Y
T	I	Y	O	E	X	R	Y	E	M	K	J	E	R	E	O
E	V	O	L	C	A	N	Y	O	N	S	Y	T	I	A	B
S	T	R	A	T	O	G	R	A	P	H	I	C	G	N	E

A CLASSROOM FULL OF RESOURCES

Objective: To reinforce the concept that natural resources are all around us.



Student Page

A Few Facts

Natural resources are substances we obtain from the land, water and air around us.

Our food, shelter and amenities of life – cars, bicycles, tents, baseballs and bats – all are made from our natural resources.

Even our pencils are from natural resources. The cedar wood is from the forests in California and Oregon. The graphite (not lead) might come from Montana or Mexico, and it's reinforced with clay from Kentucky and Georgia. The eraser is made from soybean oil and latex from trees in South America and is reinforced with pumice from California or New Mexico. The metal band is aluminum or brass made from copper and zinc, mined in no less than 13 states. The paint to color the wood and the lacquer to make it shine are made from a variety of different minerals and metals, as is the glue that holds the wood together – products from two continents, three countries and at least six states!

Classroom Experience

Label as many resources as possible that are found in the classroom.

Divide students into several teams. Assign an area of the classroom (or wherever you choose) to each team and provide each group with peel-off sticky labels.

Ask the students to label all of the natural resources in their designated areas and to list each item they label. They can then cooperatively sort the list into common components, such as wood, metals (steel or aluminum), minerals (talc-chalk), or synthetics and explain their decisions.

Suggest they do the same at home and discuss the different materials in each student's home – tile vs. linoleum, brick vs. wood, carpet vs. wood floors, metal vs. wooden window and door frames, etc.

Dig A Little Deeper

- Draw the cafeteria and label its natural resources.
- Find out what minerals used in your classroom are mined in your community, state or nation.
- Study a bicycle. How many different materials are needed to make it? Why is it important to use metal in the frame?

Integrating the Curriculum

1. Where does electricity come from? How do we harness it?
2. What is a board foot of lumber? Suggest that the children interview a few local builders or carpenters and report back to the class on the skills these professionals feel they need.
3. What effect do the various climactic changes have on construction of houses and buildings in any one area. How are buildings made "earthquake-proof?"
4. Why do we paint our houses? What do we use?
5. What are computers made of? Computers make a great themed study from manufacture, to programming, to use in schools, businesses and the home.

Read More About It!

Check out these children's books for your class:

- *Prairie Visions: The Life and Times of Solomon Butcher* by Pam Conrad; Harper-Trophy
- *What's the Big Idea, Ben Franklin?* by Jean Fritz; Putnam Publishing Group
- *If You Sailed on the Mayflower in 1620* by Ann McGovern; Scholastic
- *Woodworking*, Los Angeles Unified School District Staff (gr. 7-9); Glencoe (Macmillan)
- *The Erie Canal* by Peter Spier; Doubleday
- *Weather* by Howard E. Smith; Doubleday
- *Mineral Resources A-Z* by Robert Bates; Enslow Publishers
- *How Things Are Made, A Child's First Encyclopedia;* Random House

Video Deal

Common Ground, 26 minutes. Explains mining's role in our daily lives and the steps mining takes to lessen its impact on the environment. $10, with teacher guides. Write: SME; P.O. Box 625002; Littleton, CO 80162-5002

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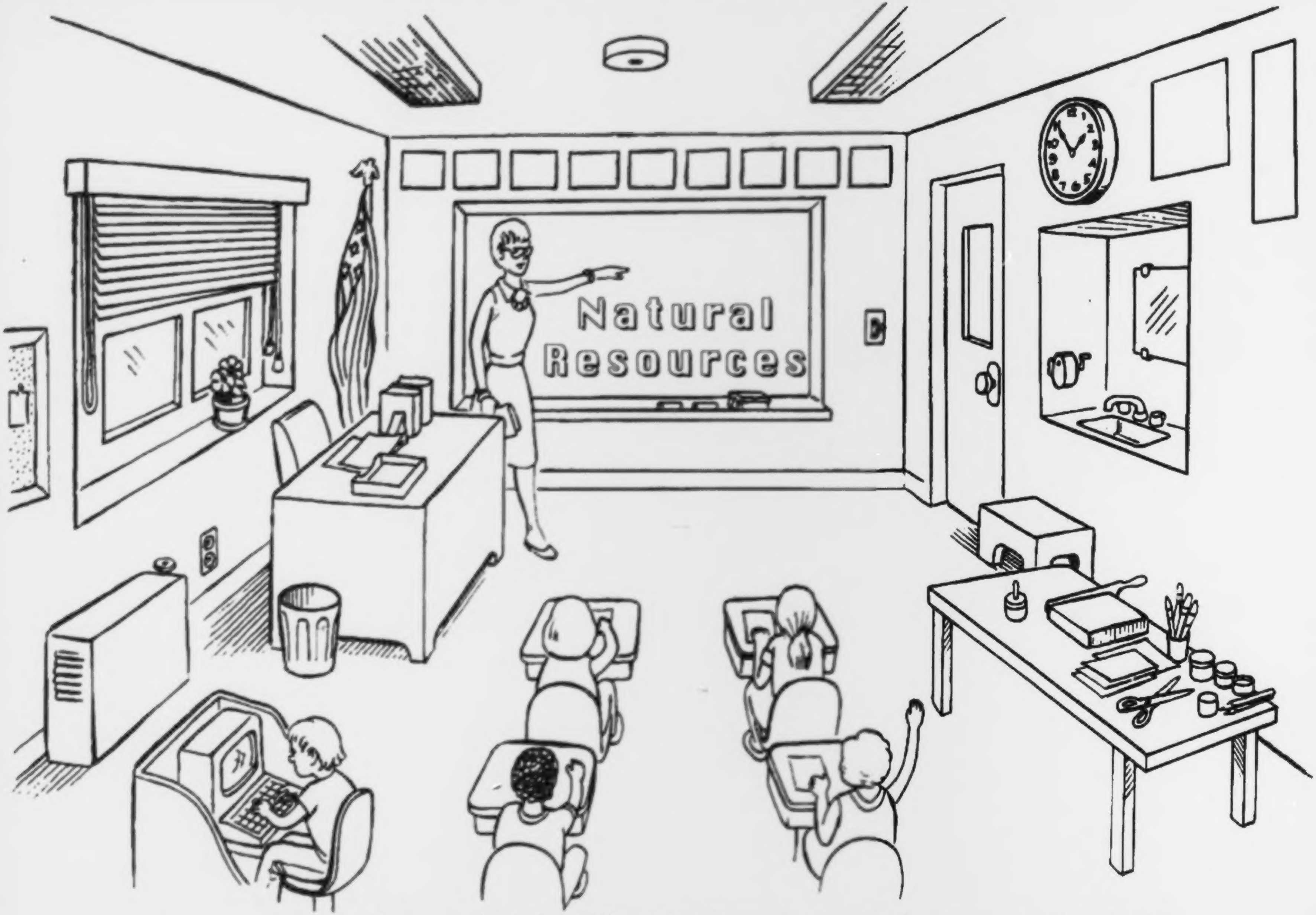
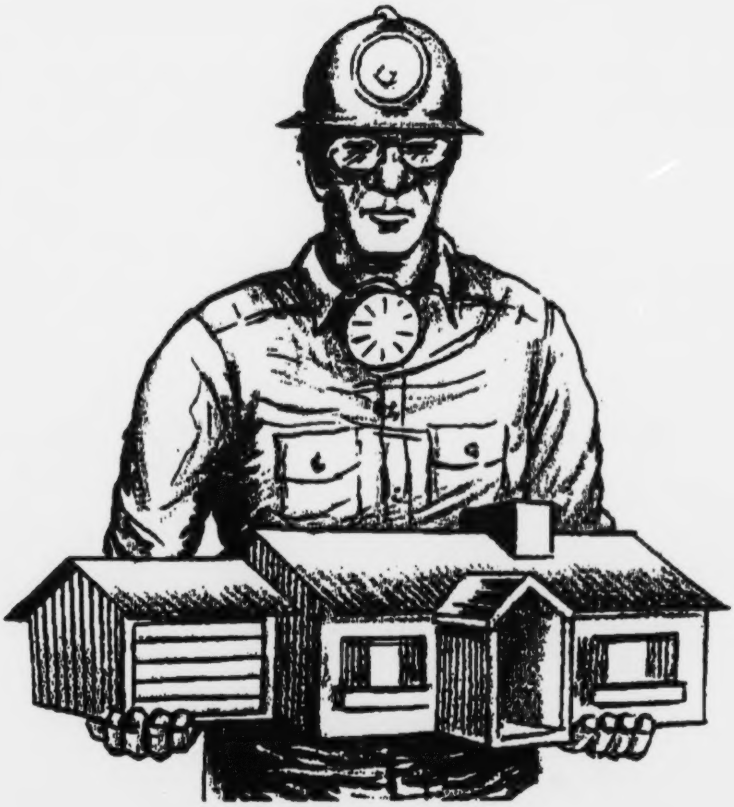
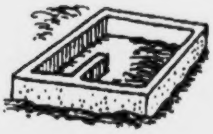

Natural Resources

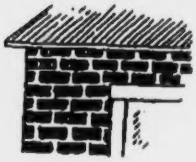
Can you find the different natural resources that were used to build your classroom? Remember, if it wasn't grown, it had to be mined.

Your House Comes From A Mine

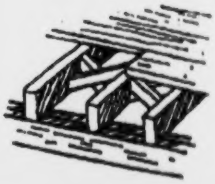




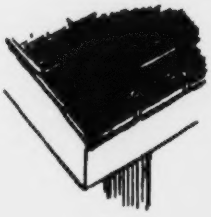
The **foundation** and **sidewalk** are probably concrete *(limestone, clay, shale, gypsum and aggregate)* and the **driveway**—concrete or asphalt *(petroleum and aggregate)*.



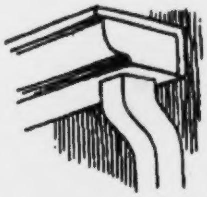
The **exterior walls** may be of *concrete* block, brick *(clay)*, *stone* or *aluminum* siding, all provided by mining.



The **lumber in the walls, roof** and **floor** will be fastened together with nails and screws *(iron ore & zinc)*.

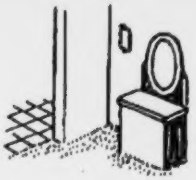


The **roof** may be covered with asphalt shingles *(petroleum* and a variety of colored *silicates)*, fiberglass *(silica sand)*, clay, or corrugated *iron*.

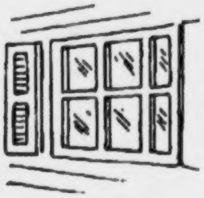


The **gutters** can be made of galvenized steel *(iron and zinc)*, aluminum *(bauxite)*, or plastic *(petroleum)*.

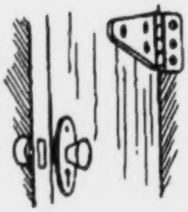
The **insulation** in the walls may be glass wool *(silica, feldspar, trona)* or expanded *vermiculite* (available from mining).



The **interior walls** are usually wallboard, made of *gypsum.*



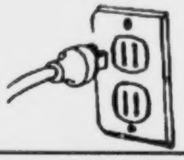
Your **windows** are made of glass *(trona, silica, sand and feldspar).*



Your **door knobs, locks** and **hinges** are brass or steel *(copper, zinc, iron ore, & alloys).*

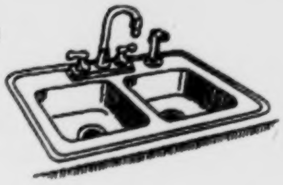
Your **fireplace** may be made of *rock, brick,* or you may have a wood/coal burning **stove** *(steel, iron, alloys, etc.).* Your **furnace** is made of steel *(iron and alloys).*

If your house is painted, **paint** is manufactured with *mineral fillers* and *pigments.*



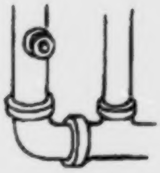
Your **electrical wiring** is of *copper* or *aluminum* (bauxite).

Your **plumbing fixtures** may be made of brass *(copper & zinc)* or stainless steel *(iron, nickel & chrome).*



Your **toilets, sinks** and **bathtubs** are made of porcelain *(clay)* over *iron*, or plastic *(petroleum).*

Your **sewer system** is made of *clay* or *iron* pipe (plastic pipes are made from *petroleum*); if you have a **septic tank** it is *concrete* and the leach field is filled with *sand and gravel.*



The **carpet** in you home is made from synthetic fibers *(petroleum).* The back is filled with *limestone*, even if your carpet is made of wool.

And finally, your **mortgage** or **rental contract** is written on paper made from wood or cloth fibers. The fibers are filled with *clay* and *other minerals* to determine its color and texture.

Your House
Came Out of the Ground

Find Out

Which of the materials used to build your house, came from your community or state? Can you discover which other states, and even other countries, were involved in producing the materials that were necessary to build your house?

MINING LEGENDS

Objective: To enrich and expand study of natural resources with literature and history.

Student Page

Read More About It!

Check out these children's books for your class:

- *Gold!...* by Milton Meltzer; Scholastic
- *One Earth (A National Audubon Series)* by Ron Hirschi; Bantam Doubleday Dell
- *Klondike Fever* by Michael Cooper; Clarion
- *White Fang* and *Call of the Wild*, by Jack London; Macmillan Children's Book Group
- Robert Service Series and *Yukon Poems* by Robert Service; Putnam Publishing Group

A teacher reference:

- *A Pictorial History of American Mining* by Howard and Lucille Sloane; Crown Publishing

A Few Facts

The first documented discovery of gold in the U.S. was made by 12-year-old Conrad Reed in 1799 while shooting fish with a bow and arrow in a North Carolina stream. Because gold was unknown in this part of the country, the boy's father kept the piece for several years and used it as a doorstop. In 1802, it was properly identified by a jeweller as gold.

Gold was mined in the U.S. prior to the Revolutionary War, but authentication of those discoveries is still missing. Some regions of Arizona have been mined for more than 600 years. The fabled Seven Cities of Cibola directed Spanish exploration of the New World in the 1500's.

The discovery of gold lured thousands of people to the American Frontier, and these prospectors settled the West.

The first authenticated U.S. gold rush was in Georgia in 1828, (though many believe that the lure of gold in Georgia did not create a true gold rush). The famous California Gold Rush began in 1849; it was followed by Colorado in 1859, South Dakota in 1874, Alaska in 1898 and Nevada in 1902.

- Gold is weighed in Troy ounces: 1 pound avoir-dupois = 14.5833 Troy ounces
- Gold content in jewelry and other applications is measured in karats. 1 karat = $\frac{1}{24}$th part. 24k is pure gold; 18k is 18 parts gold and 6 parts other metals. Most gold jewelry is 14k gold.

Classroom Experience

Discuss the term "legend." What is fact? What is fiction?

Working alone or in groups, students can create their own treasure maps based on various myths, legends and books. By exchanging maps, they may locate the well-known treasure from the map and clues provided.

Dig A Little Deeper

- Research other mining legends or legends of the Old West.
- To recreate the emotion of the California Gold Rush, pan for gold in your own classroom. Special classroom panning kits are available from MII.
- Write the legend of your classroom, or have students create their own legends and share them if they wish.

Integrating the Curriculum

1. How long is the course in the Iditerod race? How many miles per hour did the most recent winner average?
2. The Egyptians used a great deal of gold. Where did they find it? How was it mined? How much does the gold sarcophagus of King Tut weigh?
3. Why is there a Russian influence in Alaska?
4. What is the basis weight for Troy weight? (12 ounces = 1 pound) Why is it called Troy? How many Troy ounces does each student weigh?
5. Secure a street map of your community and locate the origin of its street names. Were they named for any important historical events, places or people?
6. Form several groups and have each select a decade of your state's history to research and present to the class.

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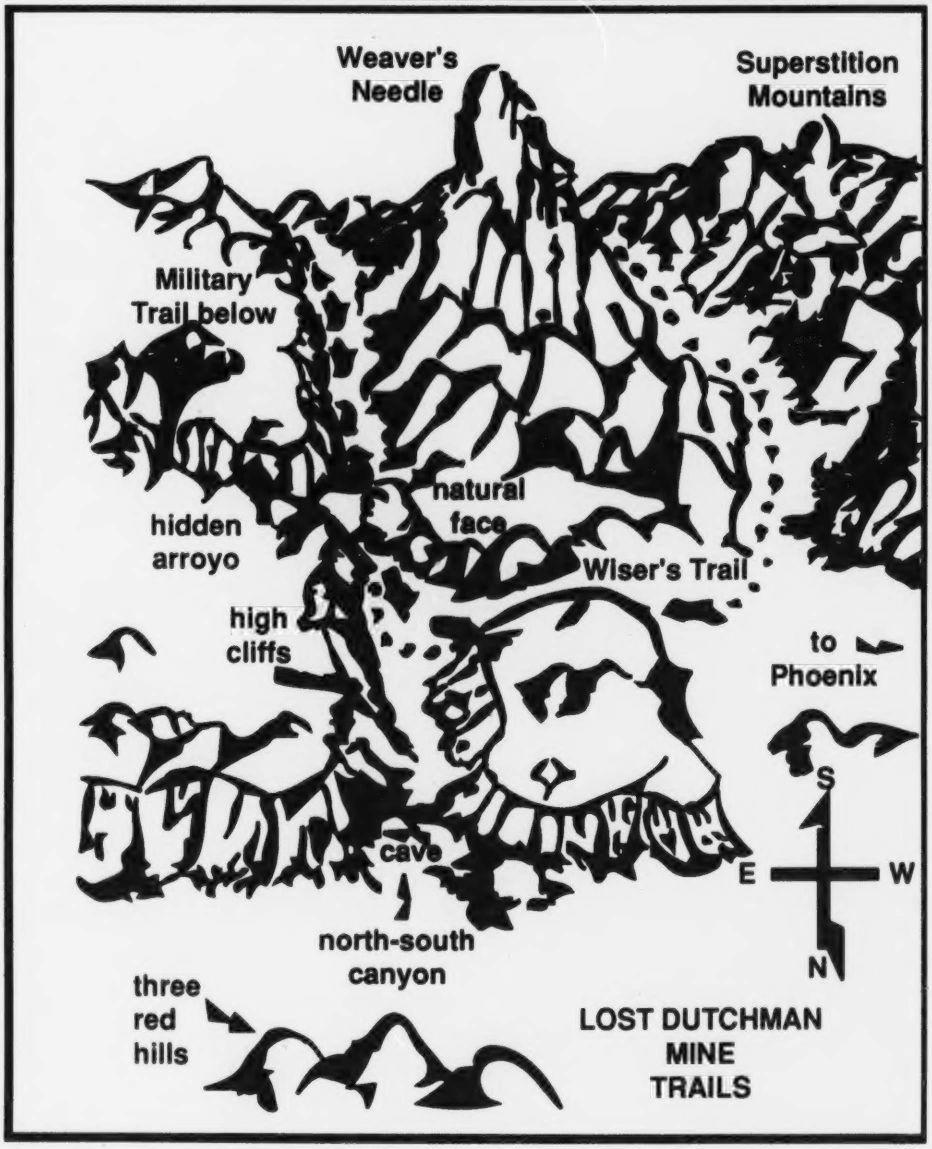
TREASURE MAP

The secret map to the GOLD of the Lost Dutchman Gold Mine, in the Superstition Mountains of Arizona


Weaver's Needle
Superstition Mountains
Military Trail below
natural face
hidden arroyo
Wiser's Trail
high cliffs
to Phoenix
S
E
W
N
cave
north-south canyon
three red hills
LOST DUTCHMAN MINE TRAILS

Listen to the Legend of the Lost Dutchman Gold Mine and see if you can find the true location of the richest gold mine in the American Frontier.

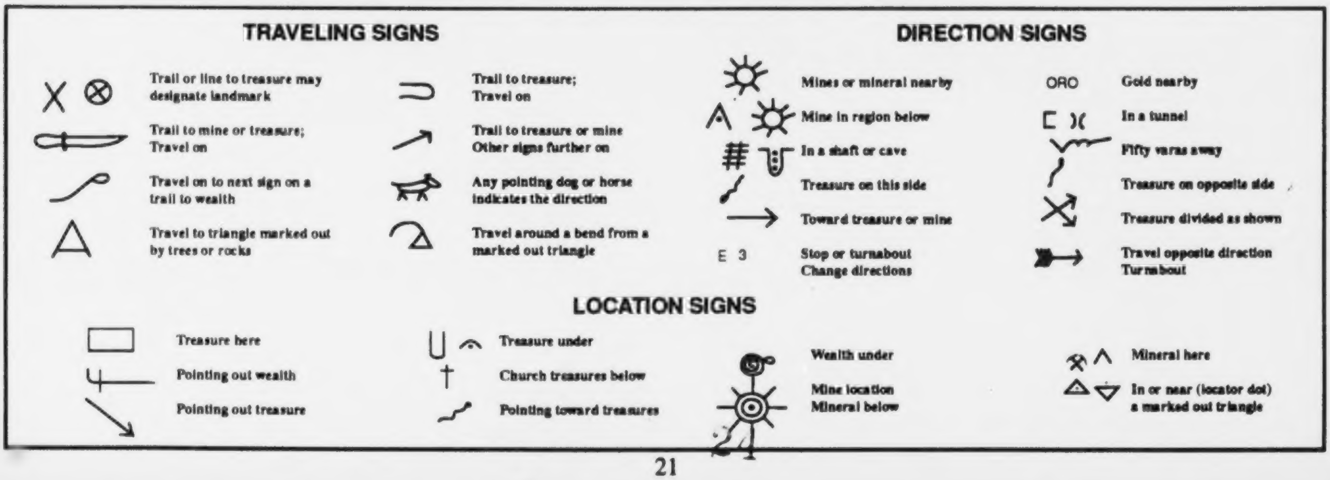
Cover Before copying

Teacher's Note

Students will not be able to find many clues at all that will lead them to the mine. That's why it is still lost.

Have the students use the symbols below to create their own treasure maps.

The Dutchman's lost mine map, modernized to show the location clues about which he told, and Wiser's Trail.



TRAVELING SIGNS

Trail or line to treasure may designate landmark

Trail to mine or treasure; Travel on

Travel on to next sign on a trail to wealth

Travel to triangle marked out by trees or rocks

Trail to treasure; Travel on

Trail to treasure or mine Other signs further on

Any pointing dog or horse indicates the direction

Travel around a bend from a marked out triangle

DIRECTION SIGNS

Mines or mineral nearby

Mine in region below

In a shaft or cave

Treasure on this side

Toward treasure or mine

E 3 Stop or turnabout Change directions

ORO Gold nearby

In a tunnel

Fifty varas away

Treasure on opposite side

Treasure divided as shown

Travel opposite direction Turnabout

LOCATION SIGNS

Treasure here

Pointing out wealth

Pointing out treasure

Treasure under

Church treasures below

Pointing toward treasures

Wealth under

Mine location Mineral below

Mineral here

In or near (locator dot) a marked out triangle

THE LEGEND OF THE LOST DUTCHMAN

America's Most Famous Gold Mine

The Lost Dutchman Gold Mine, still hidden in the Superstition Mountains east of Phoenix, Arizona, has it all—fabulous wealth, Spanish treasure maps, Apaches, claim jumping and murders, including mysterious 20th Century deaths and disappearances.

450 years ago, Coronado searched the area for the Seven Golden Cities of Cibola, the legendary wealth of earlier civilizations of the Indian and Mexican empires. For centuries, the Apaches watched as foreign men brought invading hordes in search of gold in the mountains that were their god—the Superstition Mountains.

In the winter of 1847-48 the Apaches began to attack in earnest; and when all foreigners had been destroyed, the medicine men holding solemn council upon the matter stated that, should foreigners come again to disturb the gods, the Apaches might be "forever cursed by storms and floods and all manner of the natural disasters which angry deities could contrive." So it was decreed that a band of thirty squaws and two youths would be sent back into the Superstitions to cover the mines and destroy all traces of the fabulous workings.

And there in the mountains this work party labored for one full moon, throwing ore and hastily abandoned tools back into the shafts. Then they covered the mines with stout logs, which in turn were covered with the natural caliche cement that hardens into rock. Over this they placed in cunning Indian fashion yet another covering of dirt and surface stones to match the surrounding ground.

In 1871, with the help of old Spanish treasure maps, Jacob Walz, "The Dutchman" and his partner, Wiser, were prospecting the Needles Canyon area of the Superstitions looking for lost Spanish gold. Both were well known throughout Arizona as "thorough-going scoundrels, capable of most anything." At the unmistakable sound of hammering by miners, Walz grabbed his .45-90 Sharpes, and Wiser his .45-70 Springfield, and they proceeded to ambush two miners (Jacobs and Ludi) near Weaver's Needle. Jacobs and Ludi, both mortally wounded, fled with Ludi dying soon. Jacobs stumbling on alone, finally reached Andy Starr's cabin in the desert, where he collapsed in Starr's arms, babbling wildly about Spanish-mapped mines and hidden ambushers before he, too, died.

Meanwhile, Walz and Wiser were examining the mine in a veritable frenzy of activity, for the fantastic ore was almost a third solid yellow gold. And, thought the Dutchman, wouldn't that ill-gotten wealth be worth twice as much to one of them alone? The Sharpes fired again, and Wiser was left to die in the mine. However, Wiser, like the miners before him, was able to crawl from the mine and, when found delirious in the desert by friendly Pima Indians, was taken to Col. Walker's ranch near Florence. There for days Wiser hovered between life and death, telling his incredible story of murder, bonanza gold and greedy treachery before he, too, died.

Back in the Superstitions, the Dutchman had gathered up his first sack of fabulous ore and gone to Florence, where word of his strike spread like wildfire. There he squandered his gold in an uproarious manner and regaled everyone who would listen with expansive tales of old Spanish workings and unbelievable amounts of gold. But of its location—ah, that was the secret worth a king's ransom!

Walz vanished from Florence as abruptly as he had appeared. Then, weeks later, he turned up again with more of his fantastic ore, but this time in Phoenix for another drunken spree. He told even wilder tales than before of his bonanza, which promptly whipped the little village into such a frenzy that practically every able-bodied man there made immediate and secret preparations to follow the Dutchman. However, Walz was no fool, drunk or sober. He vanished suddenly one night, dragging a blanket behind him to wipe out his trail.

A few weeks later, he reappeared. This time after his usual spree, the Dutchman, upon leaving town, not only found a stampede-sized crowd waiting to follow but saw that many more were already camped out upon the desert hoping to intercept him. After that, he continuously changed his course. His tracks often ended abruptly, as though he had sprouted wings and flown off.

Shortly afterward, he appeared in Tucson with two burro-loads of ore. It was there it was discovered that Walz had never recorded his claim, meaning anyone who found it could own it. By this time everyone in Arizona was convinced the Dutchman was secretly working a hidden bonanza. In fact, there could have been no doubt of it in the face of his well-known ore sales and continued production of the same fabulous ore for more than six years.

This game of hide and seek continued with Walz always proving to be the more canny outdoorsman. However, in 1877, advancing in age (he was now 69), and as the ever increasing persistence of followers to his golden fame spread, he decided to abandon his bonanza and retire.

In Phoenix, he rented a plot of ground and an adobe hut near Henshaw Road and 16th Street and settled down at last to a life of ease and the prosaic pastime of raising chickens and wine grapes. There he guarded his secret with all the delighted perversity of a child who knows something but won't quite tell it.

Whenever he needed money for himself or for his small group of friends (who were in frequent need), he simply went into his backyard to a certain spot, but different each time, and dug up a tin can containing gold dust and nuggets. He did that for the next 14 years, until he died on February 22, 1891.

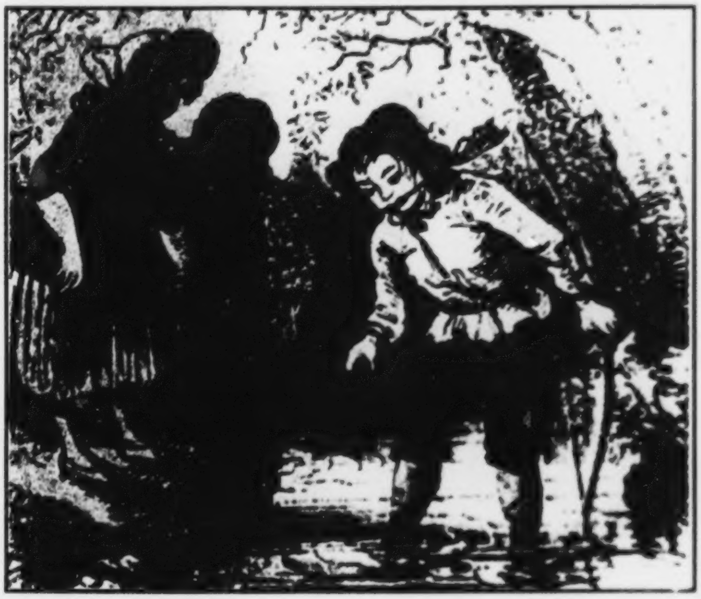
The Dutchman gave numerous clues, and even drew maps, as to the site of his now legendary mine, and more than a dozen have died trying to find it. The clues and maps are readily available, but America's most famed lost gold mine is still lost.

Source: Thunder Gods Gold, by Barry Storm

The First Authenticated Gold Discovery in America
1799

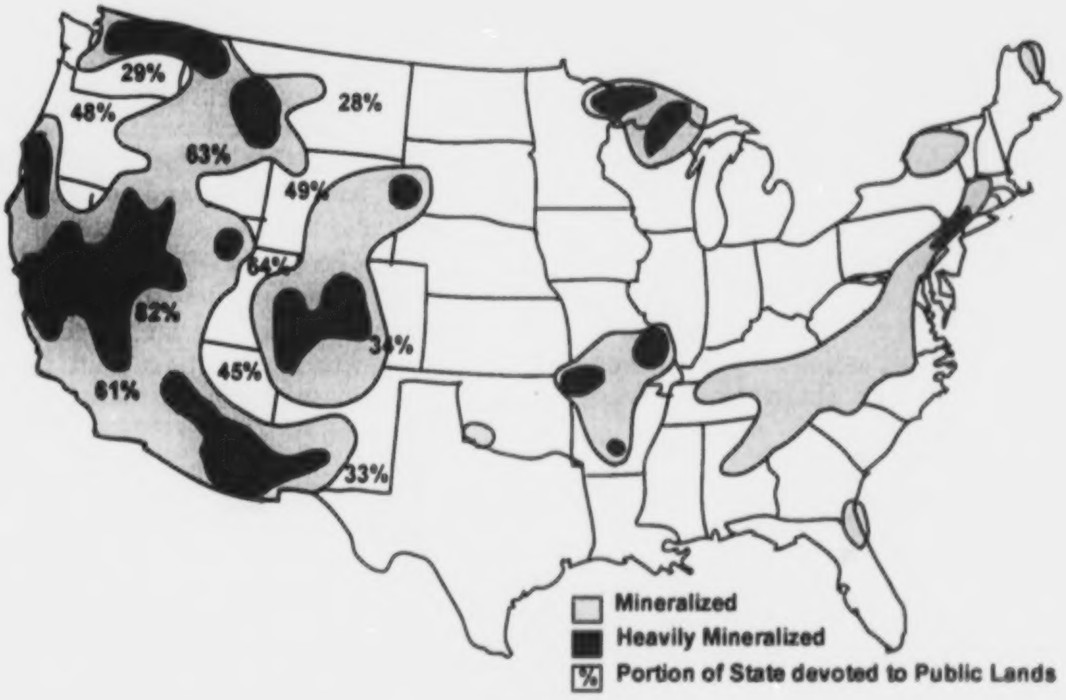
There is no doubt that gold mining occurred in "America" before the country was founded, but authentic records of discovery cannot be found. Therefore, the generally accepted first gold discovery is credited to the seventeen-pound nugget found by 12-year-old Conrad Reed in Cabarrus County, North Carolina in 1799.

According to *Historical Sketches of North Carolina 1584 to 1851*, by John H. Wheeler:

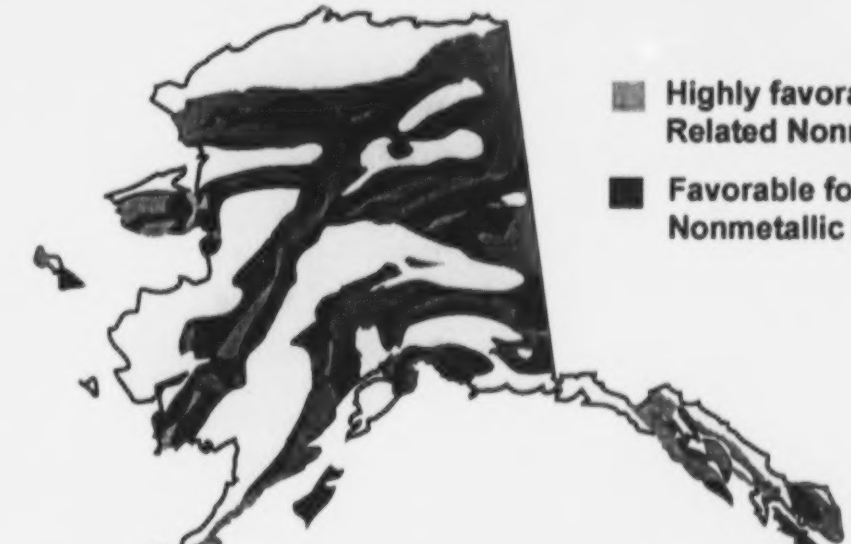


> The first piece of gold found at the mine was in the year 1799, by Conrad Reed, a boy of about twelve years old, a son of John Reed, the proprietor. The discovery was made in an accidental manner. The boy above named, in company with a sister and younger brother, went to a small stream, called Meadow Creek, on a Sabbath day, while their parents were at church, for the purpose of shooting fish with bow and arrow, and while engaged along the bank of the creek, Conrad saw a yellow substance shining in the water. He went in and picked it up, and found it to be some kind of metal, and carried it home. Mr. Reed examined it, but gold was unknown in this part of the country at that time, he did not know what kind of metal it was: the piece was about the size of a small smoothing iron.
>
> Mr. Reed carried the piece of metal to Concord, and showed it to a William Atkinson, a silversmith, but he not thinking of gold, was unable to say what kind of metal it was.
>
> Mr. Reed kept the piece for several years on his house floor, to lay against the door to keep it from shutting. In the year 1802, he went to market to Fayetteville, and carried the piece of metal with him, and on showing it to a jeweller, the jeweller immediately told him it was gold, and requested Mr. Reed to leave the metal with him and said he would flux it. Mr. Reed left it, and returned in a short time, and on his return the jeweller showed him a large bar of gold, six or eight inches long. The jeweller then asked Mr. Reed what he would take for the bar. Mr. Reed, not knowing the value of gold, thought he would ask a "big price" and so he asked three dollars and fifty cents ($3.50)! The jeweller paid him his price.
>
> After returning home, Mr. Reed examined and found gold in the surface along the creek. He then associated Frederick Kisor, James Love, and Martin Phifer with himself, and in the year 1803, they found a piece of gold in the branch that weighted twenty-eight pounds. Numerous pieces were found at this mine weighting from sixteen pounds down to the smallest particles. The whole surface along the creek for nearly a mile was very rich in gold.
>
> The veins of this mine were discovered in the year 1831. They yielded a large quantity of gold. The veins are flint and quartz.
>
> I do certify that the foregoing is a true statement of the discovery and history of this mine, as given by John Reed and his son Conrad Reed, now both dead.
>
> *January, 1848* *George Barnhardt*

Mineralized Areas


29%
48%
28%
63%
49%
64%
82%
34%
45%
61%
33%
Mineralized
Heavily Mineralized
% Portion of State devoted to Public Lands

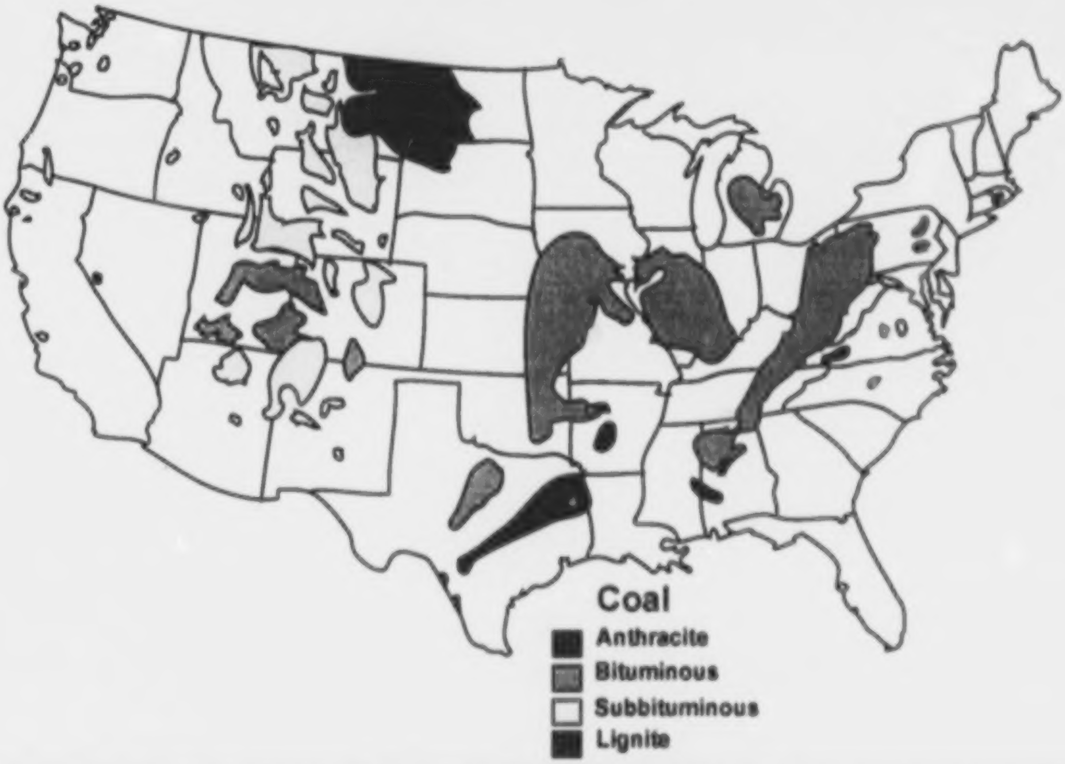
Alaskan Resources



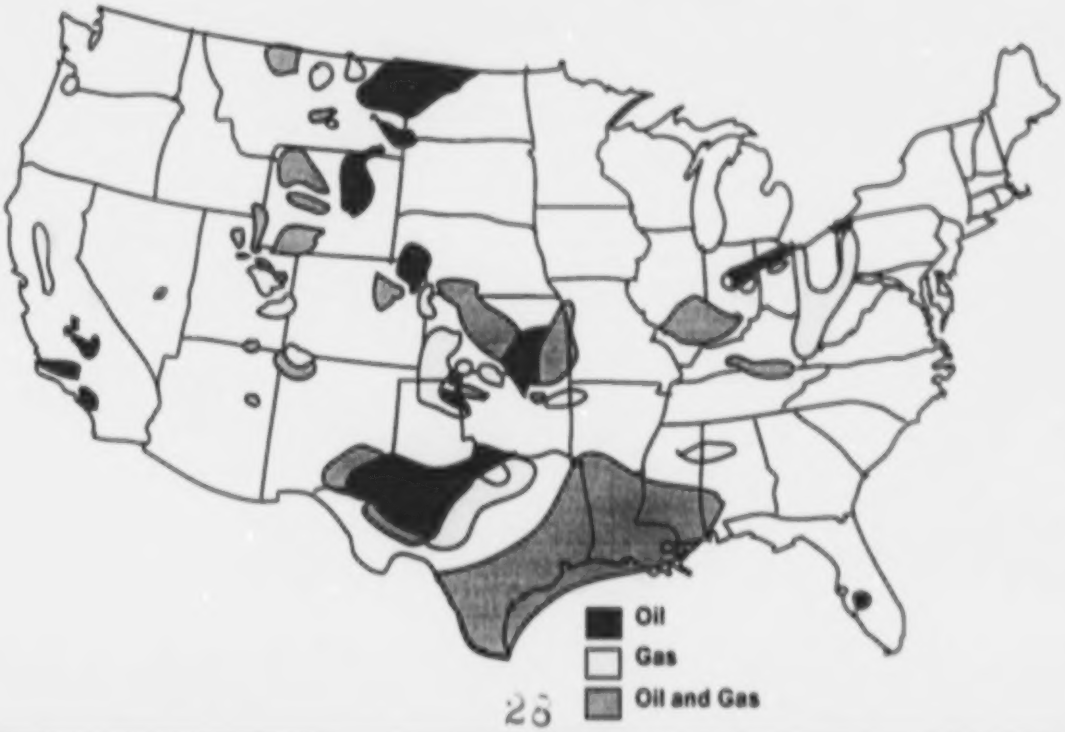
▨ Highly favorable for Metallic and Related Nonmetallic Deposits

■ Favorable for Metallic and Related Nonmetallic Deposits

Coal Fields


Coal
▨ Anthracite
▨ Bituminous
☐ Subbituminous
▨ Lignite

Oil & Gas Fields


■ Oil
☐ Gas
▨ Oil and Gas

A WORLD OF RESOURCES

Objective: To discover that world-wide cooperation is necessary to make most products.

Where Do Our Resources Come From?

Student Page

A Few Facts

In today's world, no country is truly self-sufficient; not one can produce all of the different minerals needed to maintain its own economy and society. Larger countries (because of their size) come close to self-sufficiency, but none have achieved it yet.

The economics of entire nations can depend on mineral resources. Half of the world's known gold reserves are in South Africa; petroleum is in Arab nations, copper in Chile and other minerals and metals in Canada, Siberia and Peru.

The U.S. has to import:

- 97% of the minerals needed to make aluminum
- 75% of the chromium needed to make stainless steel
- 80% of its tungsten (used in light bulbs and special steels)
- 100% of its columbium, graphite, manganese, strontium, titanium, yttrium and arsenic
- 70% (or more) of its tin, nickel and zinc (for food and medical industries)
- 47% of its petroleum (to provide the energy we all use)

Classroom Experience

Who comes closest to self-sufficiency?

Group students into six teams for the six main continents. Let each team explore and determine who controls the majority of the world's resources. Is there a concentration of minerals in one major area of a continent? In just one country? Are the countries that have more minerals more or less developed? On which countries does the U.S. most depend for minerals?

Assign different metals to the class to find out:

Why is more lead, gold and platinum recycled than aluminum? Why doesn't the U.S. mine bauxite? Where are minerals found? Where does mining occur?

Dig A Little Deeper

- What effect, if any, does the availability of natural resources have on your lifestyle? Has the need for resources ever caused war?
- What causes famine in some countries? Is it lack of food or politics?
- Why does the Organization of Petroleum Exporting Countries (OPEC) cooperate in the pricing and quantity of petroleum it produces?
- Can a country maintain its independence and quality of life without a dependable supply of natural resources? If yes, for how long? If no, what can that country do to continue its existence?

Note: Check any current event involving conflict. What role does the scarcity of resources play? Remember, resources includes the Earth's natural resources and man-made resources.

Integrating the Curriculum

1. Explore how important it is to speak the language of those countries from which one wishes to buy minerals.
2. What effect did the gold rush have on the settlement of the western frontier? On the United States? Some children might explore the origin of the word "sourdough" and then make sourdough bread.
3. What are the difficulties of extracting minerals from the Earth? Is it different in Alaska than it is in South Africa?
4. There is a feeling of brotherhood among miners. Suggest that the children discuss, role play or research why this might be so.
5. Learn some miner's songs and share your findings with MII.

Read More About It!

Check out these children's books for your class:

- *Environmental Issues Series: The Challenge of Mineral Resources, The Challenge of Supplying Energy* from Enslow Publishers
- *Spill! The Story of the Exxon Valdez* by Terry Carr, Franklin Watts
- *Industrial Minerals: How They Are Found and Used*, by Robert Bates, Enslow Publishers
- *In Coal Country* by Judith Headershot, Knopf
- *From Sea to Shining Sea*, Scholastic

Video Deal

Scientists and the Alaska Oil Spill, 22 minutes. Learn how scientists determined the best ways to clean the shorelines. Hear them assess the state of the environment. Write: Suzanne Sutphin, Exxon Company, P.O. Box 2180, Houston, TX 77252-2180.

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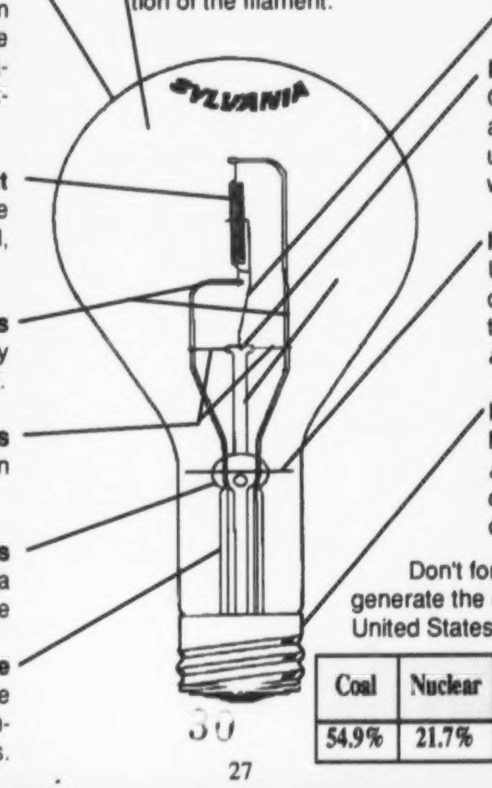
Where Do Our Resources Come From?

Something as common as a light bulb is made from the minerals and metals from nearly a dozen different countries.

Using other reference sources, find the reason why different metals are needed to make a light bulb, and the major countries where these metals are produced.



Bulb
Soft glass is generally used, made from *silica, trona (soda ash), lime, coal, and salt.* Hard glass, made from the same minerals, is used for some lamps to withstand higher temperatures and for protection against breakage.

Filament
Usually is made of *tungsten*. The filament may be a straight wire, a coil, or a coiled-coil.

Lead-in-wires
Made of *copper and nickel* to carry the current to and from the filament.

Tie Wires
Molybdenum wires support lead-in wires.

Stem Press
The wires in the glass are made of a combination of *nickel-iron* alloy core and a copper sleeve.

Fuse
Protects the lamp and circuit if the filament arcs. Made of nickel, manganese, copper and/or silicon alloys.

Gas
Usually a mixture of *nitrogen* and *argon* to retard evaporation of the filament.

Support wires
Molybdenum wires support the filament.

Button & Button Rod
Glass, made from the same materials listed for the bulb (plus lead), is used to support and to hold the tie wires placed in it.

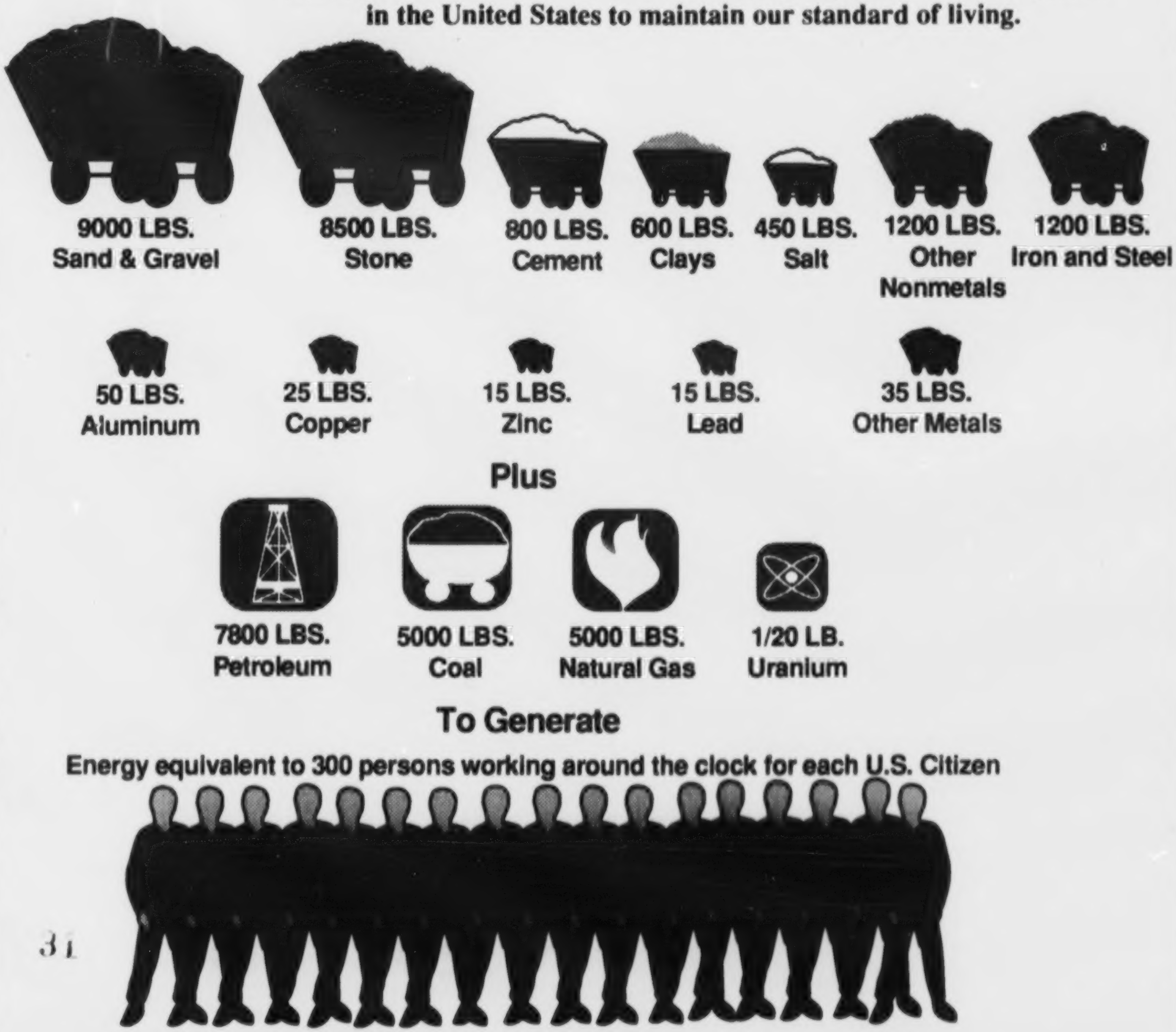
Heat Deflector
Used in higher wattage bulbs to reduce the circulation of hot gases into the neck of the bulb. It's made of *aluminum.*

Base
Made of *brass (copper and zinc)* or *aluminum.* One lead-in wire is soldered to the center contact and the other soldered to the base.

Don't forget the mineral fuels needed to generate the electricity to light up the bulb. In the United States, these are the sources of our fuels.

Coal	Nuclear	Hydro	Natural Gas	Oil	Other
54.9%	21.7%	9.8%	9.4%	3.9%	0.4%

40,000 pounds of minerals must be mined every year for every person in the United States to maintain our standard of living.



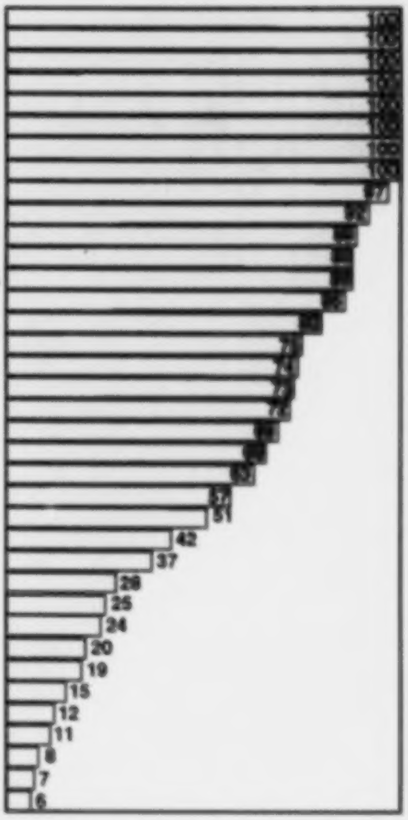
To maintain our standard of living requires the continual production of new minerals. In fact, it requires the production of 40,000 pounds of new minerals and metals every year, for every citizen in the United States.

Those minerals provide our food, our homes, schools, hospitals and factories, and the equipment and energy to make them operate. Every day, we are surrounded by minerals that help make our lives a little easier.

Per Capita Consumption of Minerals 1776 vs 1991
in pounds

	1776	1991
Aluminum	0	50
Cement	12	800
Clay	100	600
Coal	40	5,000
Copper	1	25
Iron & Steel	20	1,205
Lead	2	15
Natural Gas	0	5,000
Petroleum	0	7,870
Phosphate	1	500
Potash	1	46
Salt	4	450
Sand, Gravel, Stone	1,000	15,900
Sulfur	1	95
Zinc	0.5	15

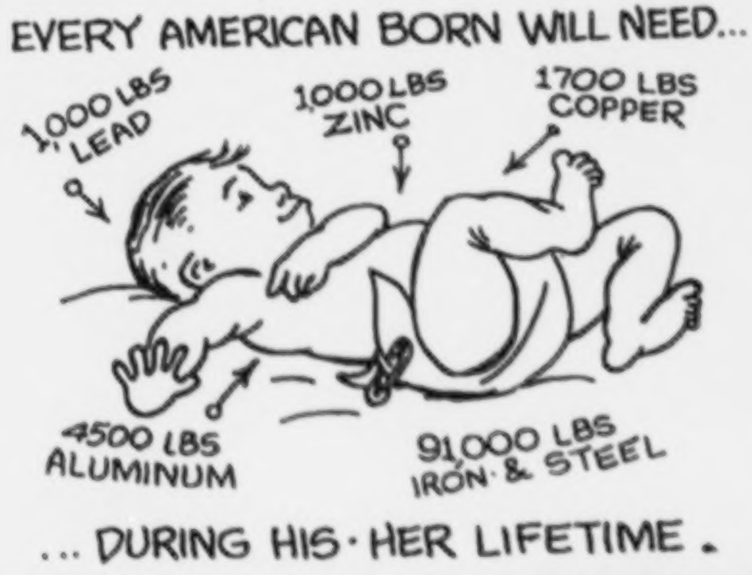
Net Imports By The United States
Selected Nonfuel Metals



Minerals/Metals	Percent Imported	Major Foreign Sources
Arsenic	100	Sweden, Canada, Mexico
Columbium	100	Brazil, Canada, Thailand, Nigeria
Graphite (strategic)	100	Mexico, China, Brazil, Madagascar
Manganese	100	South Africa, France, Gabon, Brazil
Mica (sheet)	100	India, Belgium, Japan, France, Brazil, Madagascar
Strontium (celestite)	100	Mexico, Spain, China
Titanium (rutile)	100	Australia, Japan, India
Yttrium	100	Australia
Bauxite & Alumina	97	Australia, Guinea, Jamaica, Surinam
Tantalum	[illegible]	Thailand, Brazil, Australia, Canada, Maylaysia
Diamonds (industrial)	[illegible]	South Africa, United Kingdom, Ireland, Belgium, Luxembourg
Fluorspar	[illegible]	South Africa, Mexico, Spain, Italy, China
Platinum-Group Metals	[illegible]	South Africa, United Kingdom, U.S.S.R.
Cobalt	[illegible]	Zaire, Zambia, Canada, Norway, Belgium, Luxembourg, Finland
Tungsten	[illegible]	China, Canada, Bolivia, Portugal, Republic of Korea
Chromium	[illegible]	South Africa, Zimbabwe, Turkey, Yugoslavia, U.S.S.R.
Nickel	[illegible]	Canada, Australia, Norway, Botswana, New Caldonia, Dominican Republic
Tin	[illegible]	Brazil, Thailand, Indonesia, Bolivia, Malaysia
Potash	[illegible]	Canada, Israel, East Germany, U.S.S.R.
Zinc	[illegible]	Canada, Mexico, Peru, Australia, Honduras, Spain
Cadmium	[illegible]	Canada, Mexico, Australia, West Germany, Belgium, Luxembourg
Barite	[illegible]	China, Morocco, India
Silver	57	Canada, Mexico, United Kingdom, Peru
Asbestos	51	Canada, South Africa
Ferrosilicon	42	Brazil, Canada, Norway, Venezuela
Gypsum	37	Canada, Mexico, Spain, Jamaica
Iron Ore	28	Canada, Brazil, Venezuela, Liberia
Copper	25	Canada, Chile, Peru, Zaire, Zambia, Mexico
Aluminum	24	Canada, Japan, Venezuela, Brazil
Cement	20	Canada, Mexico, Spain, Norway, Bahamas
Iron & Steel	19	E.E.C., Japan, Canada, Republic of Korea
Lead	15	Canada, Mexico, Peru, Australia, Honduras
Salt	12	Canada, Mexico, Bahamas, Chile, Spain
Beryllium	11	Brazil, China, Switzerland, South Africa
Titanium (ilmentite)	8	Japan, U.S.S.R., Australia, Canada
Nitrogen	7	Canada, U.S.S.R., Trinidad & Tobago, Mexico
Sulfur	6	Canada, Mexico

Notes: Other imported minerals and metals not shown above, include: antimony, barium, gold, mercury, selenium, pumice and volcanic cinder, and vanadium.

Belgium, Luxembourg, and the United Kindgom are not mineral producing countries, but are involved in the refining of minerals before supplying those products to other countries. E.E.C. means European Economic Community.



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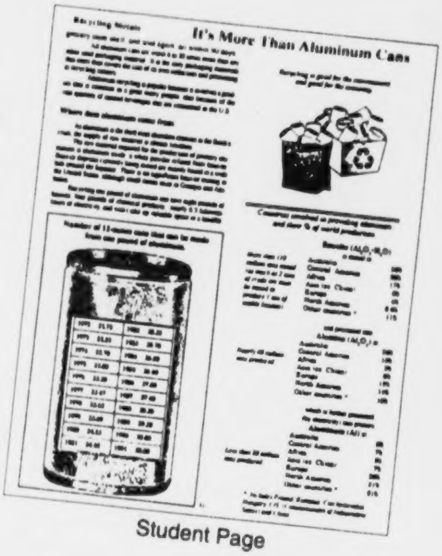
RECYCLING METALS

Objective: To appreciate our roles in producing and sharing our natural resources.



It's More Than Aluminum Cans

Student Page

A Few Facts

In the U.S., 5,500,000 metric tons of aluminum are used each year, and 50% of that is made from recycled aluminum products.

But believe it or not, when it comes to recycled metals, aluminum is not the leader. The recycling of other metals isn't generally well-known because it's done by industry, not by consumers.

The more industrialized countries (Europe and North America), while nearly void of the geologic resources to mine bauxite – the principle ore of aluminum – are deeply involved in the processing stages, called the "down-stream products."

Important Metals Used and Recycled in the U.S.

Kind of metal	% Recycled	Kind of metal	% Recycled
Antimony	43	Mercury	16
Chromium	26	Nickel	30
Cobalt	25	Platinum group metals	67
Copper	24	Selenium	20
Gold	60	Silver	49
Iron & steel scrap	100	Tin	35
Lead	65	Tungsten	33
Magnesium metal	24	Zinc	29

Classroom Experience

What do minerals have to do with world development?

Track and research the economic, manufacturing and industrial developments and trends in mainland China and the former Soviet Union. Will the regions with more mineral resources be developed more rapidly? Will there be less natural famine, a higher standard of living, opportunities for a better education, etc.?

Debate the various uses for different metals – the benefits of one metal versus another for the same application.

With mapping exercises, help the students discover that bauxite mining does indeed occur close to the equator, while aluminum processing occurs not only in other countries, but on other continents as well.

Dig A Little Deeper

Have your students form groups and research these questions:

- Why is aluminum used in beverage cans, storm window and door frames, bicycles and backpacks?
- If the price of aluminum increases, should we still use it to make beverage cans?
- Why is recycling aluminum so popular?
- Why can we make more 12-ounce cans today from a pound of aluminum than we could 20 years ago?
- How can people help recycle metals other than aluminum?

Read More About It!

Check out these children's books for your class:

- *Garbage Pizza, Patchwork Quilts and Math Magic* by Susan Ohanian; W.H. Freeman and Company
- *Captain Conservation: All About Recycling*; National Geographic
- *Recycling: Learning the Four R's: Reduce, Reuse, Recycle, Recover*, by Martin Gutnik; Enslow Publications
- *Gardens From Garbage: How to Grow Plants from Recycled Kitchen Scraps* by Judith Handelsman; Millbrook Press
- *50 Simple Things Kids Can Do to Recycle*; Earth Works Group

Video Deal

The Original Recyclers, 10 minutes. Traces history of U.S. recycling since the 19th century. Free loan, call 1-800-243-6877; request video #24974.

Integrating the Curriculum

1. Research the energy efficiency of automobiles required by Congress and the EPA and its effect on oil self-sufficiency. Are we producing a cleaner environment through efficiency and innovation? Can we recycle our way to self-sufficiency in minerals?
2. In 1992, 68% of all aluminum beverage cans were recycled, yet aluminum represents about 2% of all recovered recycleables. Study your home or school trash to see what else can be recycled.
3. Help your students pick a project that supports the environment and develops community pride, such as using the proceeds from a recycling drive to buy a park bench to donate to the town.

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It's More Than Aluminum Cans

Aluminum can recycling is now so efficient that it is possible for a beverage to be purchased at a grocery store, brought home and consumed, recycled into a new aluminum can, filled with a product, stocked on a grocery store shelf, and sold again–all within 90 days.

All aluminum cans are worth 6 to 20 times more than any other used packaging material. It is the only packaging material that more than covers the cost of its own collection and processing at recycling centers.

Aluminum recycling is popular because it involves a product that is common to a great many people: also because of the vast quantity of canned beverages that are consumed in the U.S.

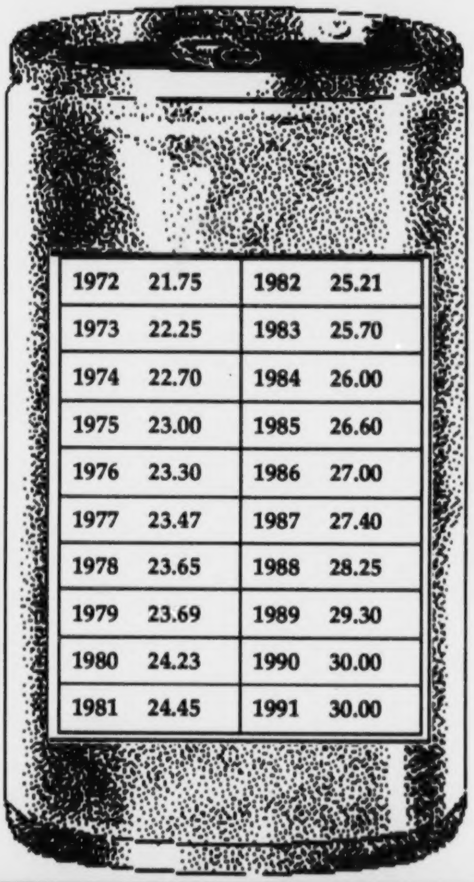
Where does aluminum come from

As aluminum is the third most abundant element in the Earth's crust, the supply of raw material is almost limitless.

The raw material required for the production of primary aluminum is aluminum oxide, a white powder refined from bauxite. Bauxite deposits currently being mined are mainly found in a wide belt around the Equator. There is no significant bauxite mining in the United States, although small deposits exist in Georgia and Alabama.

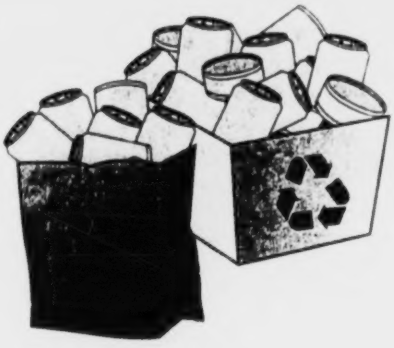
Recycling one pound of aluminum can save eight pounds of bauxite, four pounds of chemical products, nearly 6.5 kilowatt-hours of electricity, and won't take up valuable space in a landfill.

Number of 12-ounce cans that can be made from one pound of aluminum.



1972	21.75	1982	25.21
1973	22.25	1983	25.70
1974	22.70	1984	26.00
1975	23.00	1985	26.60
1976	23.30	1986	27.00
1977	23.47	1987	27.40
1978	23.65	1988	28.25
1979	23.69	1989	29.30
1980	24.23	1990	30.00
1981	24.45	1991	30.00

Recycling is good for the environment and good for the economy.



Countries involved in providing aluminum, and their % of world production.

Bauxite ($Al_2O_3 \cdot H_2O$)
is mined in

More than 110 million tons mined (as much as 2 tons of crude ore must be mined to produce 1 ton of usable bauxite)

Australia	36%
Central America	26%
Africa	17%
Asia (ex. China)	6%
Europe	4%
North America	0.0%
Other countries *	11%

and processed into
Alumina (Al_2O_3) in

Nearly 40 million tons produced

Australia	28%
Central America	18%
Africa	2%
Asia (ex. China)	6%
Europe	13%
North America	14%
Other countries *	19%

which is further processed
(by electricity) into primary
Aluminum (Al) in

Less than 20 million tons produced

Australia	8%
Central America	7%
Africa	3%
Asia (ex. China)	7%
Europe	20%
North America	31%
Other countries *	21%

** Includes Poland, Rumania, Czechoslovakia, Hungary, CIS (Commonwealth of Independent States) and China.*

HOW DO WE USE OUR LAND?

Objective: To appreciate our roles in producing and sharing our natural resources.

A Few Facts

Almost all property in the United States and Canada is controlled by land use regulations. Invite your city or county land use official to visit your class to discuss local permit rules. Some interesting areas to explore are:

- Land use: zoning changes, building permits, sewage disposal permits, well permits and business licenses.
- Living off the land: hunting and fishing licenses, mining and lumbering permits, housing code approval.

How big is an acre? Unless you live in an agricultural community, acres and hectares are hard for most people to visualize, yet almost all land uses are related to these two measurements.

- 1 acre = 43,560 sq. feet 1 hectare = 107,600 sq. feet

A high school football field equals about an acre. A hectare equals about 2½ fields.

Classroom Experience

Visit the nearest football field with your class. Encourage them to measure it in many different ways. (They could measure it in time; it would take a 10-year-old approximately 3 minutes to run around one acre.) Estimate how many houses would fit in that space. How large should each house and yard be?

Cooperatively have the class decide what support space would be needed and shared, for roads, some open space, utility poles, etc. The class can then draw up a list of the people to be employed to develop the football field into housing.

Research and discuss: Not all land is suitable for all uses.

You need land (somewhere) for agriculture so you can eat.

You need land (somewhere) for houses so you have a place to live.

You need land (somewhere) for mining to make all of the things you need.

Our interdependence as a society relies on a limited amount of land and the need to have a continual supply of resources and different uses from that land. Is there a land use we can really do without?

Dig A Little Deeper

- When the class has developed its plan for the football field (this can easily be done on a computer), ask a representative from the Planning and Zoning agency to come and discuss why – or why not – building permission would be given.
- Research the building of early frontier towns and the building of towns in the thirteen original colonies. Were housing problems different?
- After World War II, when England was rebuilding its cities, it provided for "green space" at specific distances throughout the city. What was the reason?

How Do We Use Our Land?

Student Page

Read More About It!

Check out these children's books for your class:

- *Sugaring Time* by Kathryn Lasky; Macmillan Children's Book Group
- *Cranberries* by William Jasperson; Houghton Mifflin
- *Farming* by Gail Gibbons; Holiday House
- *Reflections of a Black Cowboy* by Robert Miller; Silver Burdett Press
- *Luck of the Roaring Camp* by Bret Harte; Dover Publications
- *The Amazing Potato* by Milton Meltzer; HarperCollins

Video Deal

Mining on Public Lands, 13 minutes. Natural resource management on public lands since 1920. Also land reclamation techniques. Send $3 postage to: MII; 475 17th St., Ste. 510; Denver, CO 80202

Integrating the Curriculum

1. Develop a plan for a new city, with all support services as well as transportation to other cities. Give the class a finite measurement of space available and have them discuss (and compromise) on use of land for athletic fields or a homeless shelter.
2. Borrow soil testing materials (and an expert if you can) from your state Soil Conservation Service. Test the soil around the school and discuss soil assays' role in land development. What soil makes the best ballpark? What soil supports a building best?
3. Read a report on the quarrels between ranchers and farmers in the settlement of the west. Suggest that your class construct and role-play a court case involving these two warring factions.
4. If a television station needed to put a tower in your neighborhood, how would you feel? Why? What are the alternatives?

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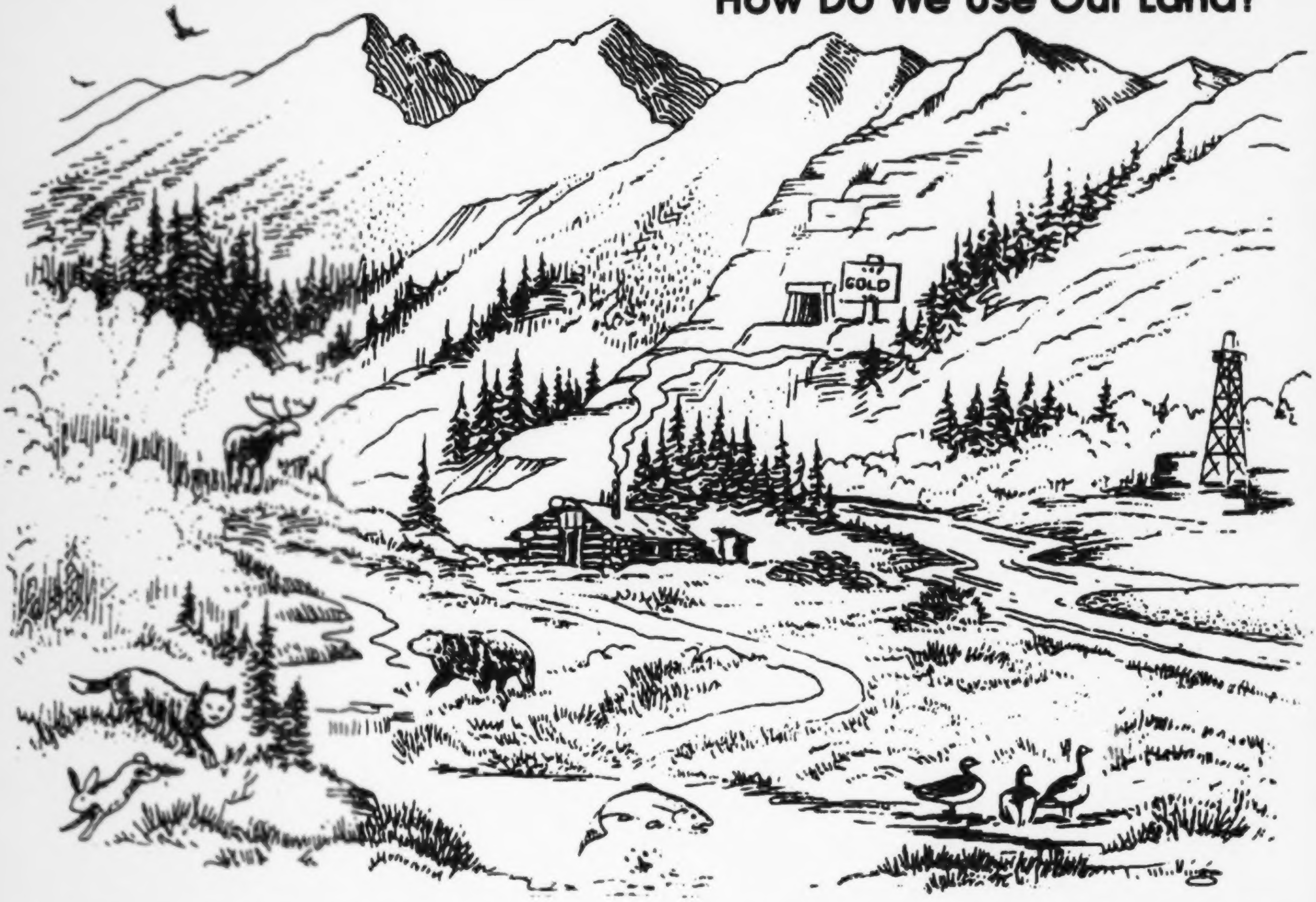
How Do We Use Our Land?



1. Let's pretend that the picture above is your property. Look at it very closely.

- a. Do you have water, plants, animals?
- b. What animals visit or live on your property, the land, the water, or in the air?
- c. Do any animals eat the plants?
- d. Do you think any of the animals you see eat any of the other animals?
- e. Is there anything under the ground? Why do you think so?
- f. The way the land looks, does it have anything to do with the animals who live here?
- g. How do you think you would like living here? Why? What do you like most about this place?

2. Name your property. Write a short story about how you spend a day there.

3. Imagine that this property has been owned by your family for many years. Although your family has always lived in the nearby town, most of the time in the past you have visited the property during vacation.

- a. What will you do with the property in the next year?
- b. What could you do with the property in the next five years? How might you use it?

You have just made a land use decision. You did this based on what you know about the land and how you feel about it. As a land manager this was the first of many decisions you will make about your land.

4. Look at the picture again. Things have changed since you first received your land. Your family finds itself without a source of income. Your property is the only means of support. You must make a living from your property and provide food, shelter, and a cash income to provide for your other needs.

- a. How could you provide your food?
- b. How will you provide shelter for your family?
- c. What resources on your property could you use to make money? How could you do so?

Remember, when you make decisions about how to use your resources, you are making an economic choice.

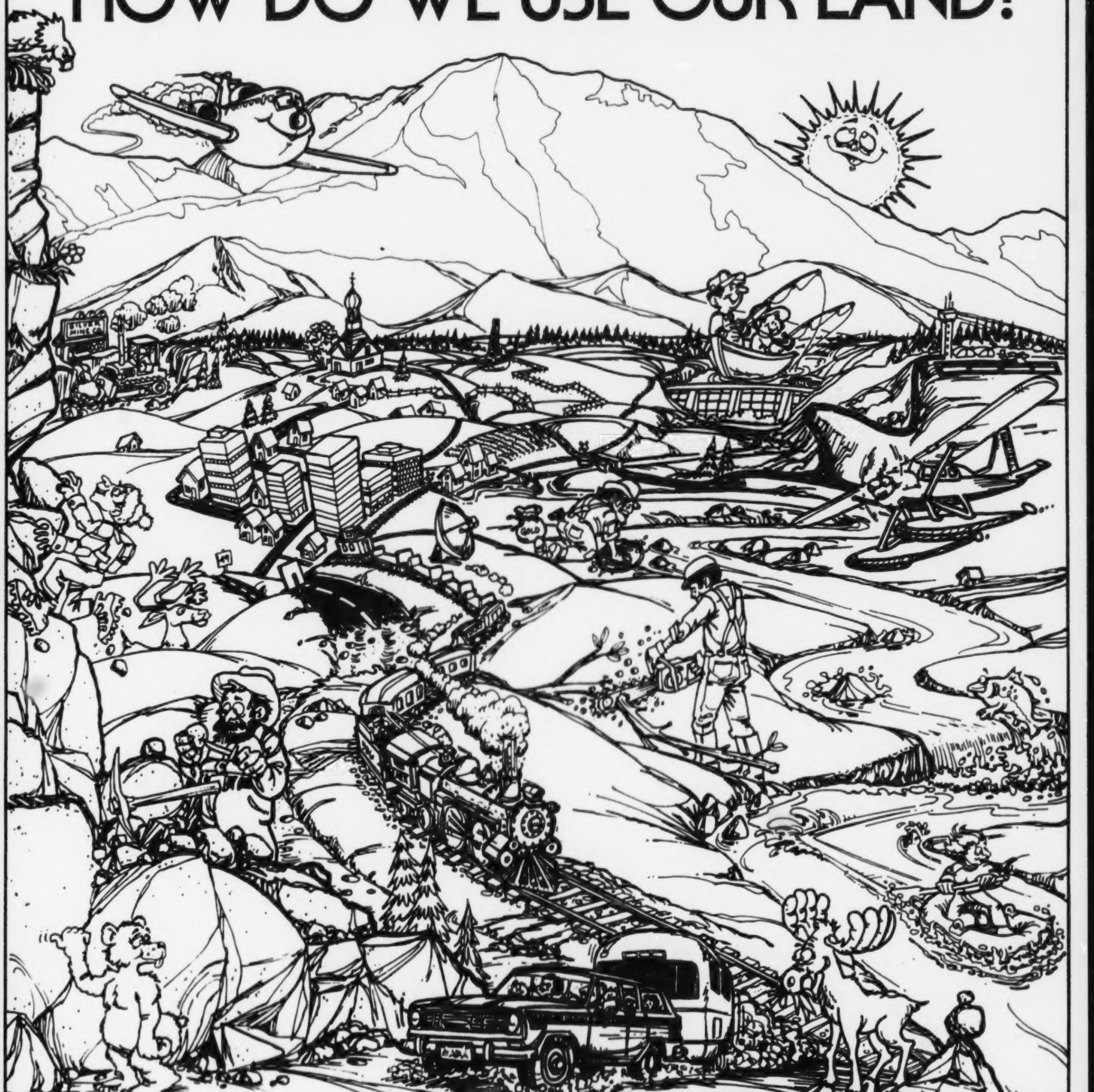
You have just made land management decisions based on your economic needs and wants. This is part of what a good land manager must do.

When you had to make decisions about your land, were you wishing you had more land? Maybe you wanted one piece of property with which to make money and another piece of land to enjoy. The problem you faced is the same one other landowners everywhere face. There is only so much land on our Earth from which we make our living and receive pleasure.

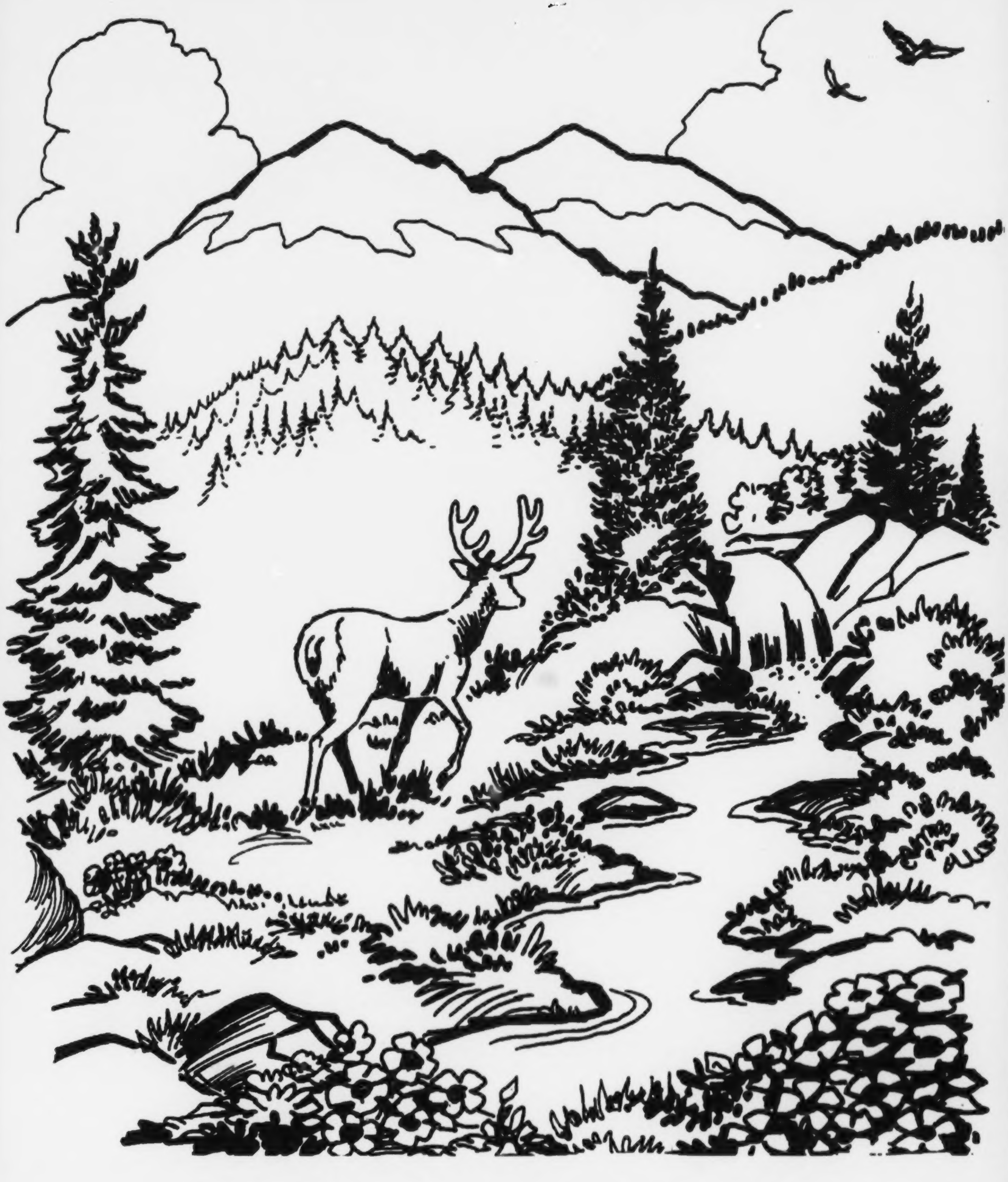
Being able to live off the land and also enjoy it, requires good problem solving and decision making skills. Many times, land can provide more than just one use.

Source: Alaska Mineral and Energy Resource Education Fund (AMEREF)

HOW DO WE USE OUR LAND?



Source: Alaska Mineral
and Energy Resource
Education Fund (AMEREF)



When a mine is finished, the land will be reclaimed so it can be used again, either by man or by nature.

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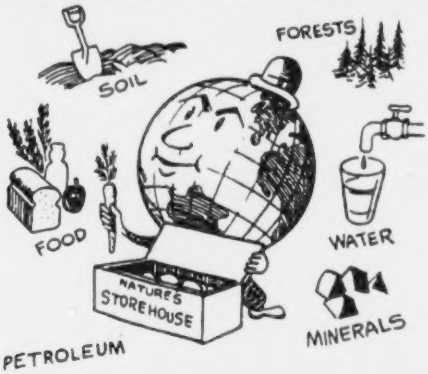
THE EARTH—NATURE'S STOREHOUSE

The Earth is a huge storehouse. It holds the water and food that plants need to grow. It has a great supply of other natural materials. Materials people use are called natural resources.

Natural resources are useful materials found on and under the Earth's surface. You use a variety of natural resources everyday. Food is a natural resource—so is water. Other resources include soil, trees, and minerals.



WHAT ARE MINERAL RESOURCES?

Mineral resources are found on and in the Earth's crust. More than 3,500 different minerals have been identified. We will study three classes of mineral resources—metals, nonmetals, and fuels. Copper, nickel, gold, silver, and iron are examples of metallic mineral resources. Common materials like sand, gravel, clay, limestone, and salt are examples of nonmetallic mineral resources. Nonmetallic minerals are often called *industrial minerals*. Minerals used for fuel are oil, gas, and coal. They are called *fossil fuels*. Uranium is a *metallic fuel*.

Minerals are everywhere around us. For example, it is estimated that more than 70 million tons of gold is in the ocean waters. It would be much too expensive to recover because it is so scattered. Minerals need to be concentrated into deposits by Earth's natural processes to be useful to us.

Some of Earth's natural processes concentrate mineral resources into valuable deposits. Moving water places sand and gravel along stream and river banks and ocean beaches. Water erodes gold-bearing rock from upland mountains and deposits gold in gravels along some rivers and streams.

Inside the Earth, rocks are melting and cooling. Melting and cooling can concentrate metals such as copper, molybdenum, nickel, and tin in a rock mass along with other common minerals like quartz and feldspar.

On the surface of the Earth, dead plants accumulated in swamps millions of years ago. Through time, heat and pressure—that plant material has become today's coal. Oil and natural gas have come from algae, spores, and plant material. Minerals may be everywhere, but only in a few places are they concentrated enough to make them valuable to us.

Mineral resources such as oil and gas, coal, copper, and tin, are called nonrenewable resources. Once they are removed from the Earth, they will not be replaced in our lifetimes. However, new mineral wealth is being created by such natural forces as volcanic activity and earthquakes.

Many minerals can be recycled. Aluminum, copper, iron, and tin are examples of reusable minerals. Coal, oil, and gas are consumed when they are burned. Therefore, they are nonrenewable.

HOW ARE MINERAL RESOURCES DISTRIBUTED THROUGHOUT THE EARTH?

Minerals are not evenly distributed in the Earth's crust. Concentrations of mineral resources profitable to extract are found in just a few small areas. Mineral deposits are really freaks of nature. In other words, a special set of circumstances happened in or on the Earth to create mineral deposits. There had to be a supply of certain elements available in the Earth, a process to concentrate them, and a host rock to trap the mineral or minerals. Many minerals like to be together, such as: quartz and gold; molybdenum, tin and tungsten; copper, lead and zinc; platinum and palladium—to name a few.

The signs of a mineral deposit are often small and difficult to recognize. Locating deposits requires the experience and knowledge of a trained geologist. Geologists search for years before finding an economic mineral deposit. Deposit size, its mineral content, extracting efficiency, and costs—ALL determine if a mineral resource can be profitably developed.

HOW ARE MINERAL RESOURCES USED TO SUPPLY FOOD?

Our food supply depends on mineral and energy resources. Farming starts with seeds in the ground and ends with food for us to eat. Plants come directly to us as fruits and vegetables—or—indirectly as food from animals that supply dairy products and meat. Growing plants get food (nourishment) from minerals in the soil. Fertilizers—such as potash, phosphate, nitrogen, and sulfur—are necessary to produce abundant crops.

That is just a start. The farmer's truck, tractor, and other machines are made from steel and other metal products. Power to operate the equipment is provided by fossil fuels such as gasoline and diesel fuel. The food products from the farm are shipped to processors or to markets in trucks, railway cars, and airplanes—all made from iron, manganese, nickel, molybdenum, and aluminum and many other minerals. The roads, highways, railroads, and airports used for food transportation are made using other mineral resources. Food is processed using equipment made from metal. Food packaging commonly is made of metal or containers made from petroleum products (such as plastic).

WHAT PRODUCTS ARE MADE FROM MINERAL RESOURCES?

Nearly ALL of the products we need to make our life more comfortable are made from mineral resources. Our society as we know it today could not function without a large and varied supply of minerals.

All products used at home, at play, and at work come from the Earth. Food, shelter, water supply, clothing, health aides, transportation, and communication all depend on mineral resources. We can see products made from minerals in the kitchen and on the dining room table. Stoves, refrigerators, dishwashers, toasters, forks, knives are good examples.

Nickel, copper, stainless steel, aluminum, and silver are necessary in cooking and eating. These products are more convenient and long-lasting and are more beneficial to our safety and health than wooden spoons, ice boxes, and dishpans.

HOW DO MINERAL RESOURCES CONTRIBUTE TO THE HOME AND INDUSTRY?

The raw materials of Earth are used to make equipment and consumer products. They are sometimes used by themselves, copper for example, or in combination with other minerals, for example: chrome, carbon and iron to make stainless steel. The output of our mines and wells makes almost every other product possible. We depend on mineral resources—they are the "building blocks" of civilization.

At home, we have instant clean water by turning on the faucet. The water treatment plant and the chemicals used for purification, the pipes and plumbing parts which bring us our water, and our waste disposal systems—are made entirely from mineral resources.

Our clothing depends on the production of mineral resources. Natural fibers grown with the aid of fertilizers are made into cloth with tools and machines made from minerals. Some textiles are made from coal and petroleum. They are called *synthetic materials*. Many coloring dyes come from minerals. Not only are these dyes used in our clothing, but are used in paints—both for household and industrial usage and works of art.

Homes, apartments, office buildings and factories are built using minerals. The structures use steel beams, gypsum for wallboard, copper wiring for telephones and electricity, and in equipment such as elevators. Zinc-coated heating ducts prevent corrosion (or rusting). The buildings sit on concrete foundations made of sand, gravel, and cement in which reinforced steel rods are embedded.

When we begin to think and investigate, we find the use of minerals is more dramatic and exciting than one can realize.

HOW ARE MINERALS USED IN TRANSPORTATION AND COMMUNICATIONS?

We now travel more and faster. We communicate by telephone, radio, and television. What has made this possible? Technology!

Aren't we glad that someone in our past invented the train? (It sure beats the horse and buggy or the wagon train.) The train, made of steel and wood, was fired by coal (eventually converted to diesel-fueled engines) that made it the transportation mode of the day. Today, we have airplanes as well as trains and automobiles.

The airplane—all of its components come from the raw materials of Earth—the same as the train and car! But, what makes it fly? What fuels it?—A highly refined kerosene made from petroleum, giving it power. It is made of light weight metals (aluminum, and specialty steels called alloys), and plastics that come from petroleum products. Its speed, because it is lightweight, makes it possible for us to travel from one coast to another in 6-1/2 hours or less.

The telephone—sure beats smoke signals! A review of history tells how exciting it was to listen to the radio and to call a friend instead of writing a letter. Today, radios, telephones, and television sets command your attention. None of these conveniences could have been made, except "someone" was interested in the advancement of society and knew how to use minerals. An understanding of minerals—the connectors so vital in today's communications—is important. As you work with your classroom computers remember that it was just a few years ago that they were made available to your school. And who could have imagined what **a quartz crystal** could do? But that quartz crystal (silicon chip) could not work alone if other minerals were not used at the same time. We are lucky!

HOW DOES THE USE AND SUPPLY OF RESOURCES DIFFER AMONG PEOPLE AND PLACES?

Mineral and energy resources are essential to everyone. A nation cannot enjoy prosperity without a reliable source. No country is entirely self sufficient when it comes to mineral and needs. Because of this interdependency, countries of the world need to cooperate.

The United States is one of the most highly industrialized nations in the world. We have a high standard of living because of our mineral and energy resource base. We have 5% of the world's population and 7% of the world's land area, but we use about 30% of the world's mineral resources. Our needs, which the consumer demands, is so large that we must buy many resources from other countries. This is called *importing*. The need for mineral and energy resources in the world continues to grow and is a major part of world trade.

WHAT IS THE FUTURE OF MINERAL RESOURCES IN THE WORLD?

The growing use of mineral and energy resources throughout the world creates several important questions. Will we reach a time when our resources are gone? It is doubtful because we are so creative and continue to develop new technology that makes minerals we use go further. We also have learned, and continue to learn, how to use our resources more efficiently and how to recycle and conserve them. Will technological development, economic factors, and conservation methods overcome fears of running out of our mineral and energy resources? Will we someday mine the ocean and resources in outer space? The answers to these questions will help determine our way of life in the future. You will be challenged to develop new ideas and new technology in the years ahead.

DIG A LITTLE DEEPER

- What does the word *concentrate* mean? Why is it important to have minerals concentrated in one place rather than scattered all around? What processes help in concentrating mineral resources?
- Name at least 3 important natural resources that can be found in your state. Why are these important?
- Pick out your favorite clothes. Look at the tags sewn inside and learn if they are made from natural fibers, synthetic fibers or both. List the fibers used to make your clothes. How did minerals play a part in the making of your clothes? (Hint—Don't forget the *sewing machine*.)

Note : The three lessons included in this section were first published in *Instructor* (1991 issues).

GEOLOGY and NATURAL RESOURCE DEVELOPMENT

Geology is a study of the Earth and its history as recorded in the rocks. The study of geology involves understanding the relationship between the rocks of the crust of the Earth and envelopes of air and water. Geology is a study of processes—processes that form continents, ocean basins, mountains, glaciers, lakes, sand bars, rocky cliffs, and deposits of minerals, coal, oil and gas. Geologists study rocks to determine what the Earth was like thousands, millions of years ago. Geologists study volcanoes, lavas, earthquakes, and landslides. They discover how mineral deposits were formed. They give us theories on how the Earth was formed, how it developed, and what the core of the Earth is like. The Earth is about 4.5 billion years old. Geology tells us how the Earth has changed and continues to change. Hills are worn down to form lowlands that may be covered by the sea. Millions of years later, rocks from under the sea may be raised up to form high mountains. The Earth is the geologists' laboratory.

WHY IS AN UNDERSTANDING OF GEOLOGY IMPORTANT TO ME?

The Earth is where we live. We are dependent upon our Earth. Our water supply and our farm land formed by geologic processes. All our minerals, fuels, and construction materials come from the Earth's crust. The Earth will remain a nice place to live if we use our resources wisely and control our wastes and garbage. There are natural earth hazards like floods, landslides, earthquakes, and volcanic eruptions. The understanding of geology can lead us to the safest areas in which to build cities, dams, schools, or roads and tunnels. If we understand geologic processes we will know the best places to dispose of our wastes and garbage, and the best geologic environments for finding oil, gas, and coal.

If we understand geology we can learn ways to use the resources of the Earth and at the same time protect it from harm.

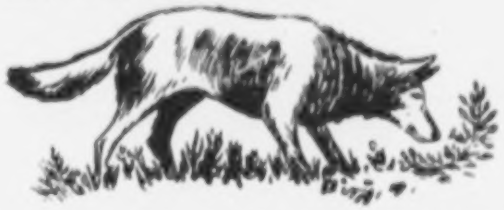
HOW DOES GEOLOGY RELATE TO MINERAL RESOURCES AND THEIR DEVELOPMENT?

Mineral resources are those minerals and other earth materials that supply the things we need and want. Look around you. Things made from mineral resources are in plain sight. Some are obvious, others are less obvious. Obviously, metal paper clips and building stone come from the Earth. Some things not so obvious—toothpaste, hair combs, chalk, cups and glasses—also come from the Earth. All plastics and many fibers of which our clothes are made come from coal or oil.

Mineral resources are so important to us that we count stages of history by them. We had the Stone Age, the Bronze Age, and the Iron Age.

By examining different kinds of rock formations and by studying the Earth's surface, geologists know the geologic environments in which mineral resources may be found.

For a long time people were able to find enough mineral resources on the surface of the Earth. This is not the case with many mineral resources today. Once a vein of silver or a bed of coal has been mined, it cannot be replaced. This means we must plan well ahead to look for new mineral deposits. Today, geologists use a variety of tools and instruments to help locate mineral resources. Airplanes and helicopters with photographic equipment are used by geologists. They also use magnetic and gravity-detecting equipment. This equipment gives information about the Earth's subsurface. Geologists sometimes use pictures taken from satellites in their search for hidden mineral resources.



In Canada, geologists have trained dogs to sniff out exploration clues. German Shepards have been taught to use their excellent sense of smell to find sulfides of lead, zinc, copper, nickel, molybdenum, and silver.

HOW WERE MINERAL RESOURCES FORMED?

As the Earth changes, different types of rocks are formed. There are three types of rocks: igneous, sedimentary, and metamorphic.

Igneous rocks are formed from magma (hot melted rock) as it cools and becomes solid. As hot magma cools, minerals such as chromite (a chrome-bearing mineral—chrome is used in stainless steel) and platinum (used in catalytic converters) form.

Sedimentary rocks are formed from particles of older rocks. The particles are deposited in a body of water, a valley, or a low plain. The collection of particles is known as sediment. After the particles are deposited, new sediment is deposited on top burying the earlier deposited materials. When sediments are buried, they become cemented to form sedimentary rock. Limestone (used to make cement and statues) and clay (used to make dishes) are examples of sedimentary rocks.

Metamorphic rocks are formed in the Earth where there is high temperature and great pressure. The heat and pressure change one kind of rock into another kind of rock. This process of change is known as metamorphism. You can think of the change from brownie dough to brownies as metamorphism. Marble (used in buildings) is metamorphosed limestone. A mineral from which tungsten (light bulb filaments are made of tungsten) is produced is formed by metamorphism.

As igneous, sedimentary, and metamorphic rocks are formed, minerals may be so concentrated as to become resources for us to use.

The Earth is always changing. Rocks are slowly worn down by the forces of weathering and erosion. Rocks can be lifted or pushed downward. They also can be moved sideways and tilted.

For example, dead trees and plants accumulate in bogs and later are buried between layers of clay and mud. The layers become sedimentary rock. The dead trees and plants are slowly changed to coal. We might say metamorphosed to coal. Oil and gas, also formed in sedimentary rock, came from decayed animals and plants.

Today, these processes continue. New coal beds are being formed in bogs and swamps; mineral deposits are being created on ocean floors by volcanic activity. Our Earth is, indeed, an exciting place to be!

WHAT IS MINERAL RESOURCE DEVELOPMENT?

Mineral resource development is finding, removing, and processing valuable mineral resources from our Earth. Mineral resources may be solid (coal or copper), liquid (petroleum), or gaseous (natural gas).

When a mineral resource is developed, it is taken from the Earth and changed into a usable form. All the work involved in doing this has one aim: to provide us with the products we need or want in our everyday lives.

A mineral resource is developed ONLY when enough of it is found concentrated in one location and its removal and processing can be done profitably. Exploration for mineral resources is a very risky business and much of it is unsuccessful. Mineral resources are scarce and difficult to find. Great sums of money are spent for years before any money is ever made by a company on its mining or drilling operations. Mineral resources can be developed only if their extraction can pay for the investment, labor and machinery, and taxes. If there is no profit left over, there is no reason to invest in such a risky business.

WHAT MUST HAPPEN TO A MINERAL RESOURCE BEFORE IT BECOMES USEFUL?

Mineral and energy resources are the ingredients in nearly all of the products we use everyday. These resources must go through a number of steps or processes before usable items can be produced. We call these steps the journey from prospect to production.

EXPLORATION. First, the mineral and energy resources must be found! The people who look for these resources are called geologists. They explore the Earth to find deposits or wells that can be produced.

EXTRACTION. After the resources are located, they must be removed from the Earth. This process is called extraction. People build surface or underground mines to extract mineral resources. To get oil, holes are drilled deep into the Earth. Mining and drilling are two ways we extract and produce mineral resources.

PROCESSING. Valuable minerals are in ordinary looking rock when they are taken from the Earth. They are often hidden as tiny particles in the rock. The valuable minerals are removed from the rock and concentrated. This is called processing or crushing, grinding, and milling.

REFINING. Some minerals have to be smelted and refined before they can be made into useful products. When oil is pumped from the Earth, it is in crude form. The crude oil is sent to a refinery where it is processed into oils, solvents, fuels, and petrochemicals.

MANUFACTURING. After the mineral and energy resources are refined, these raw materials are made into products. Their transformation into consumer products is almost limitless. Products ranging from fertilizers to plastic; from bicycles to airplanes are made by man and machinery. This is called manufacturing.

MARKETING. Once the products are made, they are sold or marketed. When you need a product, you usually go to a store. Marketing is when some product is sold to someone. The mineral and energy resource company sells the mineral resource to a manufacturer. The manufacturer makes a product and sells it to stores. The stores then sell the product to us.

DIG A LITTLE DEEPER!

The word **geology** comes from Greek words. Find out what they are and their meaning.

There are many branches of geology, such as geochemistry, geophysics, and mineralogy. Do some research to find more fields of geology and what each studies.

If you were a geologist, what tools and equipment would you need? What qualifications do you need to become a geologist?

For a wonderful imaginary trip through the inside of the Earth read *How to Dig a Hole to the Other Side of the World* by Faith McNulty (HarperCollins Childrens Books, 1990). Paperback

Be a ROCKHOUND! Start collecting rocks and minerals. Identify your rocks by using reference books from the library. Maybe you can meet a geologist who will help you. Share your collection with the class.

Make a list of 10 rocks and minerals and, using a book from your school library classify the rocks. Example: granite—igneous; limestone—sedimentary; marble—metamorphic.

Why can't we just find a mineral resource and use it as is instead of having to process it?

Choose one thing in your classroom or home that you like to use. Try to find what mineral resources it contains.

Find out more about the "Ages." Choose the Stone Age; Bronze Age; or Iron Age —and list at least five important facts about it.

Take a field trip through your neighborhood and record as many different uses of rocks and minerals as you can.

Some elements have strange sounding names. Look up molybdenum, vanadium, beryllium, selenium, and zirconium. What can you find out about each? In what products are they used?

Imagine that you are involved in one of the activities listed below. Write a description of the setting using each of your senses. Describe what it looks like, what it smells like, what it sounds like, what it feels like, and what it tastes like. Try to write a vivid description of your setting so it will actually "come alive" to another person who might read it.

- exploring in a remote area of the arctic or tropics
- working hundreds of feet below the Earth's surface in an underground mine
- working on an oil drilling rig in the ocean
- processing oil in a refinery
- working in a factory to turn a processed mineral resource (raw material) into a useful product

COPPER—THE ANCIENT METAL

Man's first use of the Earth's natural resources was in the form of grasses, trees, animals, and stone. Tools and weapons were made from wood, bone and rock. Flint, a form of silica, was one of the stones first used because it is a hard, dense mineral and could be flaked into a usable shape. Obsidian, a hard glassy volcanic rock, was also used. A steel knife, today, is no sharper than an obsidian knife or spear point.

Ancient people were our first "geologists" and "miners." They not only determined which rocks were best to use, but they learned how to make them into tools, hunting spears, arrows, fishhooks and ornaments. Shaping the stone was done by flaking it with sharp blows on the edges using another stone or deer antlers.

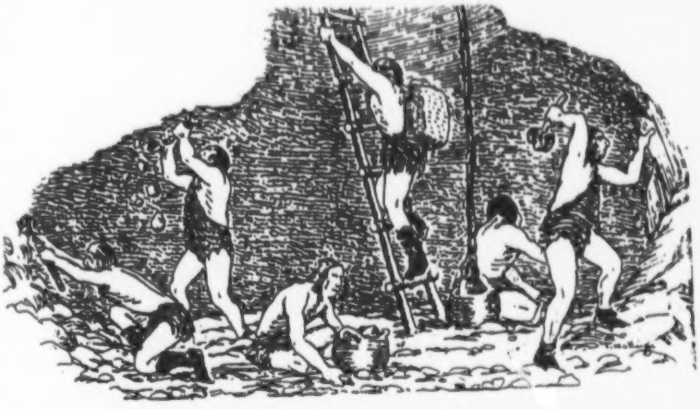
Stone-Age people knew nothing of metal. Colorful minerals were used for decoration or for barter. When emerald-green **malachite** (a copper ore) or a rusty-red **hematite** iron ore were found, they would be ground to a powder and used as pigments to decorate the face and body. They also used these and other colorful minerals pigments to paint the walls of caves and protected coves. Today, many minerals are used for paint pigments.

Can you imagine how excited these people were when they found native copper? It could be formed into decorative shapes and tools more easily than stone by pounding it with a stone on a hard surface. This great discovery was sometime after 6000 B.C.and is known as the *Copper Age*.

Flaking, grinding and pounding— were society's first forms of manufacturing. Therefore, Earth's resources were converted for man's use! The island of Cyprus, from which the word copper is derived, was a major source of copper to the Roman empire.

Over 4,000 years ago, when it was discovered that minerals could be melted, curiosity led man to combine melted metals (alloys). By accident they made bronze by adding tin to copper (the *Bronze Age*). Another combination of zinc and copper made brass. Both bronze and brass are stronger than pure copper. They do not corrode in air or water. Without these combinations of minerals and man's knowledge of mining and separating them, we would not have enough copper to take care of our needs today.

When copper tarnishes, it turns green to black on the surface. Some of the biggest deposits of copper were found by accident when prospectors noticed greenish rock protruding from the ground (this is called an *outcrop*). Many of these discoveries were huge mountains of copper ore that also contained other important minerals.



Throughout the thousands of years since native copper was discovered, man has made great use of this element. Copper has a chemical symbol, as do all elements. It is **Cu**. Minerals are seldom found in a pure state. They are found bonded together with other minerals.

Copper is one of the most useful of the metals, and probably the one first used by man. It is found native and in a variety of combinations with other minerals. It is often a by-product from silver and molybdenum ores. Copper has many colors from yellowish-to-reddish brown, red, pink, blue, green, and black. The colors are determined by the other elements (minerals) combined with the copper.

Copper is malleable, ductile and long lasting. Copper conducts heat and electricity better than any other metal except silver. It has a wide use in electric and electronic equipment. It is used for tubing and pipes for plumbing and can be made into sheets for roofing. Copper also is used in chemical compounds. Copper chemicals are used in plant sprays and to treat swimming pools to keep algae from growing. Copper and its alloys are important for parts of automobiles, airplanes, missiles and satellites.

Recycling of copper has been ongoing for many, many years. It is collected as scrap metal and separated from other metals and materials by smelting and refining. Recycled copper is called secondary copper, and it is processed at brass mills and made into new things for our use.

Since ancient man and his use of flint and obsidian we have learned a lot about our Earth and its many resources.

Each day, scientists learn more about the mineral wealth locked in our planet's crust. More is learned about new mineral wealth being born through volcanic activity. Earthquakes sometimes take away ore deposits. And at other times earthquakes bring new mineral deposits closer to the Earth's surface.

Science and technology have shown us how to find, extract, process, and use mineral resources to the benefit of man. We are lucky to live in this time of history.

COPPER FACTS

Copper is a *native element*. The crystal system of native copper is cubic. It has a metallic luster and a specific gravity of 8-9 with a hardness of 2-1/2 to 3 and can be easily scratched with a knife. Native copper has no cleavage and its fracture is hackly. This element is heavy, ductile and malleable. Native copper is copper red on fresh fracture but may be greenish or bluish or tarnished if weathered. It is often found with small amounts of arsenic, antimony, bismuth, iron, and silver.

Copper Ores:

Malachite (pronounced mala-kite) is usually a bright green color and has a non-metallic luster. It has a light green streak and can always be scratched with a knife. Malachite, a copper carbonate, is an important ore of copper and is a good indicator of copper deposits. In its pure form it contains 57% copper, the rest is made up of carbonate and water.

Azurite also is a copper carbonate. It's streak is light blue. Malachite and azurite frequently occur together and are found in the upper weathered (oxidized) zones of copper ore bodies. Azurite is the scarcer of the two has a soft blue color.

Chalcopyrite is an iron-copper sulfide. It has a brass yellow color. It is distinguished from pyrite by being softer and yellower. Its golden glint when in small specks in quartz often is mistaken for gold. The glint will disappear when turned at certain angles to the light while gold appears the same at all angles. Chalcopyrite is the primary ore of copper and is prevalent wherever copper ore is being mined below the surface zone.

Chalcocite is a copper sulfide. It is one of the highest grade and most important ores of copper and is opaque with a dark lead gray to black color. Chalcocite is often associated with and shows alteration to azurite, bornite, covellite, malachite, and native copper. Important deposits are found in Arizona's Bagdad, Jerome, and Superior areas. Other localities include Bingham, Utah;Santa Rita, New Mexico; Ely, Nevada, and the Genesee Valley district in California.

Bornite is a copper-iron sulfide. Its color is a natural bronze, but on exposure it tarnishes to the varigated colors that have caused it to be nick-named "Peacock ore." It is rarely found on the surface but is prevalent in deeper levels of copper mines.

Turquoise is a hydrous aluminum phosphate with copper. To be desirable for gems the color should be green blue. The color is due to the presense of copper and is found near the surface of copper deposits. Sometimes in may appear as an outcrop.

Chrysocolla has various shades of blue to green and is a hydrous copper silicate. It is often found with azurite and malachite. Although its color is attractive, it is too soft to make good gem stones. Be aware of this fact when buying jewelry. Sometimes chrysocolla is passed off as turquoise.

The Sewing Machine—Its Story

Attempts to invent a sewing machine date as far back as 1775. But not until 1830 was a practical machine invented. Its inventor was Bathelemy Thimmonier of France. It made a "chain stitch" with a hooked needle and was built out of wood.

Around 1848, Elias Howe (an American) invented the "eye needle" which made a "lock stitch" and had a small shuttle that carried the thread through the loop made by the needle. An improved sewing machine was developed in 1850 with the invention of of a round bobbin and hook by Allen Benjamin Wilson. Both machines were hand operated. **Isaac Singer** invented the foot treadle and a presser foot that kept the fabric in place.

Today, electricity has replaced the foot treadle. Sewing machines have motors. Motors are powered by electricity—which is another gift from **copper**!

DIG A LITTLE DEEPER

- What other elements are classified as *native*?
- Take the new words you have learned today and put them in a list. Now, use them to make a Word Search. Try your word search on a classmate or someone at home.
- If there is copper or another mineral in your area, is it being mined? If so, write a letter to the mining company to find out if they give school tours. Maybe the company has a speaker who would come to your class to tell you more. Ask!
- If you look around your classroom or your home you will find many things in which copper is used. Some are hidden — like the wiring inside a wall that brings electricity into your home or school. How many other uses can you discover?

Note: to see pictures of copper and other minerals check your library or local bookstore. Malachite and Native Copper were both pictured in the November 1991 issue of *Instructor*.

For further reacing get a copy of *The Metalsmiths*, Time -Life Books, New York, • 1974, Library of Congress number 73-89680

MINERAL USES 40 common minerals and metals

Where Do They Come From
Why Are They Important

Aluminum: The most abundant metal element in the Earth's crust. Bauxite is the main source of aluminum. Aluminum is used in the United States in packaging (31%), transportation (22%), and building (19%). Guinea and Australia have 46 percent of the world's reserves. Other countries with major reserves include Brazil, Jamaica, and India.

Antimony: A native element; antimony metal is extracted from stibnite and other minerals. Antimony is used as a hardening alloy for lead, especially storage batteries and cable sheaths; also used in bearing metal; type metal; solder; collapsible tubes and foil; sheet and pipes; and, semiconductor technology.

Asbestos: because this group of silicate minerals can be readily separated into thin, strong fibers that are flexible, heat resistant, and chemically inert, asbestos minerals are suitable for use in fireproof fabrics, yarn, cloth, paper, paint filler, gaskets, roofing composition, reinforcing agent in rubber and plastics, brake linings, tiles, electrical and heat insulation, cement, and chemical filters.

Barium: used as a heavy additive in oil-well-drilling mud; in the paper and rubber industries; as a filler or extender in cloth, ink, and plastics products; in radiography ("barium milkshake"); as getter (scavenger) alloys in vacuum tubes; deoxidizer for copper; lubricant for anode rotors in X-ray tubes; spark-plug alloys. Also used to make an expensive white pigment.

Bauxite: a general term for a rock composed of hydrated aluminum oxides; it is the main ore of alumina to make aluminum; also used in the production of synthetic corundum and aluminous refractories.

Beryllium: used in the nuclear industry and in light, very strong alloys used in the aircraft industry. Beryllium salts are used in fluorescent lamps, in X-ray tubes and as a deoxidizer in bronze metallurgy. Beryl is the gem stones emerald and aquamarine.

Chromite: 99 percent of the world's chromite is found in South Africa and Zimbabwe. Chemical and metallurgical industries use 85% of the chromit ed in the U.S.

Cobalt: used in superalloys for jet engines; chemicals (paint driers, catalysts, magnetic coatings); permanent magnets; and cemented carbides for cutting tools. Principal cobalt producing countries include Zaire, Zambia, Canada, Cuba, and the former Soviet Union. The United States uses about one-third of total world consumption. Cobalt resources in the United States are low grade and production from these deposits is not economically feasible.

Columbite-tantalite group (columbium is another name for niobium): the principal ore of niobium and tantalum, used mostly as an additive in steel making and in superalloys; used in metallurgy for heat-resistant alloys, rust-proofing (stainless steel), and electromagnetic superconductors. Brazil and Canada are the world's leading producers.

Copper: used in electric cables and wires, switches, plumbing, heating; roofing and building construction; chemical and pharmaceutical machinery; alloys (brass, bronze, and a new alloy with 3% beryllium that is particularly vibration resistant); alloy castings; electroplated protective coatings and undercoats for nickel, chromium, zinc, etc. The leading producer is Chile, followed by the U.S., the former Soviet Union, Canada, Zambia, and Zaire.

Feldspar: a rock-forming mineral; industrially important in glass and ceramic industries; pottery and enamelware; soaps; abrasives; bond for abrasive wheels; cements and concretes; insulating compositions; fertilizer; poultry grit; tarred roofing materials; and as a sizing (or filler) in textiles and paper.

Fluorite (fluorspar): used in production of hydrofluoric acid, which is used in the pottery, ceramics, optical, electroplating, and plastics industries; in the metallurgical treatment of bauxite, which is the ore of alumina; as a flux in open hearth steel furnaces and in metal smelting; in carbon electrodes; emery wheels; electric arc welders; toothpaste; and paint pigment.

Gold: used in dentistry and medicine; in jewelry and arts; in medallions and coins; in ingots as a store of value; for scientific and electronic instruments; as an electrolyte in the electroplating industry. South Africa has about half of the world's resources. Significant quantities are also present in the U.S., Australia, Brazil, Canada, China, and the former Soviet Union.

Gypsum: processed and used as prefabricated wallboard or as industrial or building plaster; Used in cement manufacture; agriculture and other uses.

Halite (Sodium chloride—Salt): used in human and animal diet, food seasoning and food preservation; used to prepare sodium hydroxide, soda ash, caustic soda, hydrochloric acid, chlorine, metallic sodium; used in ceramic glazes; metallurgy; curing of hides; mineral waters; soap manufacture; home water softeners; highway deicing; photography; herbicide; fire extinguishing; nuclear reactors; mouthwash; medicine (heat exhaustion); in scientific equipment for optical parts. Single crystals used for spectroscopy, ultraviolet and infrared transmission.

Iron Ore: used to manufacture steels of various types. Powdered iron: used in metallurgy products; magnets; high-frequency cores; auto parts; catalyst. Radioactive iron (iron 59): in medicine; tracer element in biochemical and metallurgical research. Iron blue: in paints, printing inks; plastics; cosmetics (eye shadow); artist colors; laundry blue; paper dyeing; fertilizer ingredient; baked enamel finishes for autos and appliances; industrial finishes. Black iron oxide: as pigment; in polishing compounds; metallurgy; medicine; magnetic inks; in ferrites for electronics industry. Major producers of iron ore include Australia, Brazil, China, and the former Soviet Union.

Lead: used in lead batteries, gasoline additives and tanks, and solders, seals or bearings; used in electrical and electronic applications; TV tubes, TV glass, construction, communications, and protective coatings; in ballast or weights; ceramics or crystal glass; tubes or containers, type metal, foil or wire; X-ray and gamma radiation shielding; soundproofing material in construction industry; and ammunition. The U.S. is the world's largest producer and consumer of lead metal. Other major mine producers include Australia, Canada, and the former Soviet Union.

Lithium: lithium compounds are used in ceramics and glass; in primary aluminum production; in the manufacture of lubricants and greases; rocket propellants; vitamin A synthesis; silver solders; underwater buoyancy devices; batteries.

Manganese: essential to iron and steel production. The U.S., Japan, and Western Europe are all nearly deficient in economically minable manganese. South Africa and the former Soviet Union have over 70% of the world's reserves.

Mica: micas commonly occur as flakes, scales, or shreds. Sheet muscovite (white) mica is used in electronic insulators (mainly in vacuum tubes); ground mica in paint, as joint cement, as a dusting agent, in well-drilling muds; and in plastics, roofing, rubber, and welding rods.

Molybdenum: used in alloy steels (47% of all uses) to make automotive parts, construction equipment, gas transmission pipes; stainless steels (21%) used in water distribution systems, food handling equipment, chemical processing equipment, home, hospital, and laboratory requirements; tool steels (9%) bearings, dies, machining components; cast irons (7%) steel mill rolls, auto parts, crusher parts; super alloys (7%) in furnace parts, gas turbine parts, chemical processing equipment; chemicals and lubricants (8%) as catalysts, paint pigments, corrosion inhibitors, smoke and flame retardants, and as a lubricant. As a pure metal, molybdenum is used because of its high melting temperatures (4,730 °F.) as filament supports in light bulbs, metalworking dies and furnace parts. Major producing countries are Canada, Chile, and the U.S.

Nickel: vital as an alloy to stainless steel; plays key role in the chemical and aerospace industries. Leading producers include Australia, Canada, Norway and the former Soviet Union. Largest reserves are found in Cuba, New Caledonia, Canada, Indonesia, and the Philippines.

Perlite: expanded perlite is used in roof insulation boards; as fillers, filter aids, and for horticultural.

Platinum Group Metals (includes platinum, palladium, rhodium, iridium, osmium, and ruthenium): they commonly occur together in nature and are among the scarcest of the metallic elements. Platinum is used principally in catalysts for the control of automobile and industrial plant emissions; in catalysts to produce acids, organic chemicals, and pharmaceuticals. PGMs used in bushings for making glass fibers used in fiber-reinforced plastic and other advanced materials, in electrical contacts, in capacitors, in conductive and resistive films used in electronic circuits; in dental alloys used for making crowns and bridges; in jewelry. The former Soviet Union and South Africa have nearly all the world's reserves.

Potash: a carbonate of potassium; used as a fertilizer; in medicine; in the chemical industry; used to produce decorative color effects on brass, bronze, and nickel.

Pyrite: used in the manufacture of sulfur, sulfuric acid, and sulfur dioxide; pellets of pressed pyrite dust are used to recover iron, gold, copper, cobalt, nickel, etc.; used to make inexpensive jewelry.

Quartz (Silica): as a crystal, quartz is used as a semiprecious gem stone. Cryptocrystalline forms may also be gem stones: agate, jasper, onyx, carnelian, chalcedony, etc. Crystalline gem varieties include amethyst, citrine, rose quartz, smoky quartz, etc. Because of its piezoelectric properties quartz is used for pressure gauges, oscillators, resonators, and wave stabilizers; because of its ability to rotate the plane of polarization of light and its transparency in ultraviolet rays it is used in heat-ray lamps, prism, and spectrographic lenses. Used in the manufacture of glass, paints, abrasives, refractories, and precision instruments.

Rare Earth Elements: industrial consumption of rare earth ores was primarily in petroleum fluid cracking catalysts, metallurgical additives, ceramics and polishing compounds, permanent magnets, and phosphors. Rare earth elements are lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium.

Silica: used in manufacture of glass and refractory materials; ceramics; abrasives; water filtration; component of hydraulic cements; filler in cosmetics, pharmaceuticals, paper, insecticides; rubber reinforcing agent, especially for high adhesion to textiles; anti-caking agent in foods; flatting agent in paints; thermal insulator. Fused silica is used as an ablative material in rocket engines, spacecraft; silica fibers used in reinforced plastics.

Silver: used in photography, chemistry, jewelry; in electronics because of its very high conductivity; as currency, generally in some form of an alloy; in lining vats and other equipment for chemical reaction vessels, water distillation, etc.; catalyst in manufacture of ethylene; mirrors; electric conductors; batteries; silver plating; table cutlery; dental, medical, and scientific equipment; electrical contacts; bearing metal; magnet windings; brazing alloys, solder. Silver is mined in 56 countries. Nevada produces over 30% of the U.S. silver. Largest silver reserves are found in the U.S., Canada, Mexico, Peru, and the former Soviet Union.

Sodium Carbonate (Soda Ash or Trona): used in glass container manufacture; in fiberglass and specialty glass; also used in production of flat glass; in liquid detergents; in medicine; as a food additive; photography; cleaning and boiler compounds; pH control of water.

Stibnite (the main ore of Antimony): used for metal antifriction alloys, metal type, shot, batteries; in the manufacture of fireworks. Antimony salts are used in the rubber and textile industries, in medicine; and glassmaking.

Sulfur: used in the manufacture of sulfuric acid, fertilizers, chemicals, explosives, dyestuffs, petroleum refining; vulcanization of rubber; fungicides.

Tantalum: A refractory metal with unique electrical, chemical, and physical properties is used to produce electronic components tantalum capacitors; used for high-purity tantalum metals in products ranging from weapon systems to superconductors; capacitors; chemical equipment; dental and surgical instruments; rectifiers; vacuum tubes; furnace components; high-speed tools; catalyst; sutures and body implants; electronic circuitry; thin-film components. Used in optical glass and electroplating devices. Australia, Brazil, Canada and Thailand are the leading producers. There is no tantalum mining in the United States.

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Titanium: a metal used mostly in jet engines, airframes, and space and missile applications; produced in the westerns and central U.S., the United Kingdom, China, Japan, and the former Soviet Union.

Tungsten: used in metalworking; construction and electrical machinery and equipment; in transportation equipment; as filament in light bulbs; as a carbide in drilling equipment; in heat and radiation shielding; textile dyes, enamels, paints, and for coloring glass. Major producers are China, Korea, and the former Soviet Union. Large reserves are also found in the U.S., Bolivia, Canada, and The Federal Republic of Germany.

Vanadium: used in metal alloys; important in the production of aerospace titanium alloys; as a catalyst for production of maleic anhydride and sulfuric acid; in dyes and mordants; as target material for X-rays. The former Soviet Union and South Africa are the world's largest producers of vanadium. Large reserves are also found in the U.S. and China.

Zeolites: used in aquaculture (fish hatcheries for removing ammonia from the water); water softener; in catalysts; cat litter; odor control; and for removing radioactive ions from nuclear plant effluent.

Zinc: used as protective coating on steel, as die casting, as an allying metal with copper to make brass, and as chemical compounds in rubber and paints; used as sheet zinc and for galvanizing iron; electroplating; metal spraying; automotive parts; electrical fuses; anodes; dry cell batteries; fungicides; nutrition (essential growth element); chemicals; roof gutters; engravers' plates; cable wrappings; organ pipes; in pennies; as sacrificial anodes used to protect ship hulls from galvanic action; in catalysts; in fluxes; in phosphors; and in additives to lubricating oils and greases. Zinc oxide: in medicine, in paints, as an activator and accelerator in vulcanizing rubber; as an electrostatic and photoconductive agent in photocopying. Zinc dust: for primers, paints, sherardizing, precipitation of noble metals; removal of impurities from solution in zinc electrowinning. Zinc is mined in over 50 countries with Canada the leading producer, followed by the former Soviet Union, Australia, Peru, and China. In the U.S. mine production mostly comes from Tennessee, Missouri, New York and Alaska.

MAJOR MINERAL and ENERGY OCCURRENCES - UNITED STATES

There are known reserves of the following mineral materials in nearly every state: construction sand and gravel, crushed stone, a variety of industrial minerals, and gemstones.

Alabama: Asphalt (At); Bauxite (Al); Clay (Cl); Coal (C); Iron Ore (Fe); Limestone (Ls); Marble (Mr); Mica (Mi); Salt (Na); and, Petroleum (O).

Alaska: Beryl (Be); Coal (C); Copper (Cu); Gold (Au); Iron Ore (Fe); Mercury (Hg); Molybdenum (Mo); Natural Gas (G); Petroleum (O); Platinum (Pt); Tungsten (W); Uranium (U), and, Zinc (Zn).

Arizona: Asbestos (Ab); Copper (Cu); Gold (Au); Gypsum (Gp); Lead (Pb); Mercury (Hg); Molybdenum (Mo); Silver (Ag); Uranium (U); Vanadium (V); and, Zinc (Zn).

Arkansas: Barite (Ba); Bauxite (Al); Bromine (Br); Clay (Cl); Coal (C); Diamonds (D); Gypsum (Gp); Marble (Mr); Natural Gas (G); Petroleum (O); Soapstone (Sp), and, Zinc (Zn).

California: Asbestos (Ab); Borax (Bx); Bromine (Br);Clay (Cl); Copper (Cu); Gold (Au); Gypsum (Gp); Iron Ore (Fe); Lead (Pb); Lithium (Lt) Magnesium (Mg); Marble (Mr); Mercury (Hg); Molybdenum (Mo); Natural Gas (G); Petroleum (O); Platinum (Pt); Potash (K); Rare Earths (RE); Salt (Na); Silver (Ag); Talc (Tc); Tungsten (W); and, Zinc (Zn).

Colorado: Beryl (Be); Clay (Cl); Coal (C); Copper (Cu); Fluorspar (F); Gold (Au); Iron Ore (Fe); Lead (Pb); Marble (Mr); Mica (Mi); Molybdenum (Mo); Natural Gas (G); Petroleum (O); Silver (Ag); Tungsten (W); Uranium (U); Vanadium (V); and, Zinc (Zn).

Connecticut: Clay (Cl); and, Mica (Mi).

Delaware: Marl (Greensand) and Magnesium (Mg+) Compounds (from sea water)

Florida: Clay (Cl); Limestone (Ls); Peat (Pe); Phosphates (P); Titanium (Ti); and, Zirconium (Zr).

Georgia: Barite (Ba); Bauxite (Al); Clay (Cl); Gold (Au); Granite (Gn); Iron Ore (Fe); Manganese (Mn); Marble (Mr); Mica (Mi); Slate (Sl); Talc (Tc); and, Titanium (Ti).

Hawaii: Clay (Cl). Volcanic activity is building unknown mineral wealth at this time.

Idaho: Antimony (Sb); Cobalt (Co); Copper (Cu); Gold (Au); Iron Ore (Fe); Lead (Pb); Mercury (Hg); Phosphates (P); Silver (Ag); Thorium (Th); Titanium (Ti); Vanadium (V); Tungsten (W); and, Zinc (Zn).

Illinois: Clay (Cl); Coal (C); Fluorspar (F); Lead (Pb); Limestone (Ls); Petroleum (O); and Zinc (Zn).

Indiana: Clay (Cl); Coal (C); Gypsum (Gp); Limestone (Ls); Natural Gas (G); and, Petroleum (O).

Iowa: Clay (Cl); Coal (C); Gypsum (Gp); and, Limestone (Ls).

Kansas: Clay (Cl); Coal (C); Gypsum (Gp); Helium (He); Lead (Pb); Limestone (Ls); Natural Gas (G); Petroleum (O); Salt (Na); and, Zinc (Zn).

Kentucky: Clay (Cl); Coal (C); Fluorspar (F); Limestone (Ls); Natural Gas (G); and, Petroleum (O).

Louisiana: Gypsum (Gp); Natural Gas (G); Petroleum (O); Salt (Na), and, Sulfur (S).

Maine: Clay (Cl); and, Mica (Mi).

Maryland: Clay (Cl); Coal (C); Limestone (Ls); and, Natural Gas (G).

Massachusetts: Granite (Gn); and, Limestone (Ls).

Michigan: Bromine (Br); Clay (Cl); Copper (Cu); Gypsum (Gp); Iron Ore (Fe); Limestone (Ls); Natural Gas (G); Peat (Pe); Petroleum (O); Potash (K); and, Salt (Na).

Minnesota: Clay (Cl); Cobalt (Co); Copper (Cu); Granite (Gn); Iron Ore (Fe); Limestone (Ls); Manganese (Mn); and Nickel (Ni).

Mississippi: Clay (Cl); Iron Ore (Fe); Natural Gas (G); and, Petroleum (O).

Missouri: Barite (Ba); Clay (Cl); Coal (C); Copper (Cu); Iron Ore (Fe); Lead (Pb); Limestone (Ls); Marble (Mr); Natural Gas (G); Silver (Ag); and, Zinc (Zn).

Montana: Copper (Cu); Gold (Au); Graphite; Gypsum (Gp); Lead (Pb); Manganese (Mn); Natural Gas (G); Petroleum (O); Palladium (Pd); Phosphates (P); Platinum (Pt); Silver (Ag); Thorium (Th); Tungsten (W); Vermiculite; and, Zinc (Zn).

Nebraska: Clay (Cl); Natural Gas (G); and Petroleum (O).

Nevada: Barite (Ba); Clay (Cl); Copper (Cu); Gold (Au); Gypsum (Gp); Lead (Pb); Lithium (Lt); Magnesium (Mg); Mercury (Hg); Molybdenum (Mo); Petroleum (O); Salt (Na); Silver (Ag); Sulfur (S); Tungsten (W); and, Zinc (Zn).

New Hampshire: Beryl (Be); Granite (Gn); Mica (Mi); and, Thorium (Th).

New Jersey: Clay (Cl); Titanium (Ti); and, Zinc (Zn).

New Mexico: Coal (C); Copper (Cu); Gold (Au); Gypsum (Gp); Lead (Pb); Marble (Mr); Molybdenum (Mo); Natural Gas (G); Petroleum (O); Potash (K); Salt (Na); Silver (Ag); Uranium (U); Vanadium (V); and, Zinc (Zn).

What's The Difference

mineral An inorganic substance occurring in nature, though not necessarily of inorganic origin, which has (1) a definite chemical composition or, more commonly a characteristic range of chemical composition, and (2) distinctive physical properties or molecular structure.

metal An opaque, lustrous, elemental, chemical substance that is a good conductor of heat and electricity and, when polished, a good reflector of light.

industrial mineral Rocks and minerals not produced as sources of the metals but excluding mineral fuels.

New York: Clay (Cl); Emery; Garnet; Gypsum (Gp); Iron Ore (Fe); Lead (Pb); Limestone (Ls); Natural Gas (G); Petroleum (O); Salt (Na); Sandstone (Ss); Silver (Ag); Slate (Sl); Talc (Tc); Titanium (Ti); and, Zinc (Zn).

North Carolina: Asbestos (Ab); Clay (Cl); Copper (Cu); Gold (Au); Granite (Gn); Lithium (Lt); Marble (Mr); Mica (Mi); Phosphates (P); Talc (Tc); and, Tungsten (W).

North Dakota: Clay (Cl); Lignite (Lg); Natural Gas (G); Petroleum (O); Salt (Na); and, Uranium (U).

Ohio: Clay (Cl); Coal (C); Gypsum (Gp); Limestone (Ls); Natural Gas (G); Petroleum (O); Salt (Na); and, Sandstone (Ss).

Oklahoma: Coal (C); Copper (Cu); Gypsum (GP); Helium (He); Lead (Pb); Limestone (Ls); Natural Gas (G); Petroleum (O); and, Zinc (Zn).

Oregon: Gold (Au); Mercury (Hg); Silver (Ag); and, Uranium (U).

Pennsylvania: Clay (Cl); Coal (C); Cobalt (Co); Iron Ore (Fe); Limestone (Ls); Natural Gas (G); Petroleum (O); Sandstone (Ss); Slate (Sl); and, Zinc (Zn).

Rhode Island: Sand and Gravel (SG) and Crushed Stone (CS)

South Carolina: Clay (Cl); and, Mica (Mi).

South Dakota: Beryl (Be); Gold (Au); Granite (Gn); Mica (Mi); Petroleum (O); Silver (Ag); Uranium (U); and, Vanadium (V).

Suggested Activities

Can you and your class identify other mineral resources found in your state?

With this listing, identify the minerals that are scarce within the geographical boundaries of the United States. Use a map to plot your findings.

Plot on a map the states that have mineral resources like those found in your state.

Does your state have wind power? Solar power? Geothermal power? Hydropower?

Does your state have oil refineries? If so, name the city or cities where the refineries are located.

Tennessee: Clay (Cl); Coal (C); Copper (Cu); Iron Ore (Fe); Limestone (Ls); Marble (Mr); Phosphates (P); Pyrites (S); Sandstone (Ss); and, Zinc (Zn).

Texas: Asphalt (At); Clay (Cl); Granite (Gn); Graphite (Gr); Gypsum (Gp); Helium (He); Iron Ore (Fe); Limestone (Ls); Natural Gas (G); Petroleum (O); Salt (Na); Silver (Ag); Sulfur (S); Talc (Tc); and Uranium (U).

Utah: Asphalt (At); Beryllium (Be); Clay (Cl); Coal (C); Copper (Cu); Gallium (Ga); Germanium (Ge); Gold (Au); Gypsum (Gp); Iron Ore (Fe); Magnesium (Mg); Molybdenum (Mo); Natural Gas (G); Petroleum (O); Phosphates (P); Potash (K); Salt (Na); Silver (Ag); Uranium (U); and Vanadium (V).

Vermont: Asbestos (Ab); Granite (Gn); Marble (Mr); Slate (Sl); and, Talc (Tc).

Virginia: Clay (Cl); Coal (C); Gypsum (Gp); Lead (Pb); Limestone (Ls); Slate (Sl); Soapstone (Sp); Titanium (Ti); and, Zinc (Zn).

Washington: Clay (Cl); Coal (C); Copper (Cu); Gold (Au); Gypsum (Gp); Lead (Pb); Magnesium (Mg); Marble (Mr); Silver (Ag); Talc (Tc); Uranium (U); Tungsten (W); and, Zinc (Zn).

West Virginia: Clay (Cl); Coal (C); Limestone (Ls); Natural Gas (G); Petroleum (O); and, Salt (Na).

Wisconsin: Copper (Cu); Iron Ore (Fe); Lead (Pb); Limestone (Ls); and, Zinc (Zn).

Wyoming: Clay (Cl); Coal (C); Diamonds (D); Iron Ore (Fe); Natural Gas (G); Petroleum (O); Phosphate (P); Uranium (U); and, Vanadium (V).

Find Out

- How far the sand and gravel must be transported to make your sidewalks?
- How many miles crushed stone must be transported to be used as road-fill for the road in front of where you live?

How much more does it cost to make the sidewalks, driveways, and house foundations when the sand and gravel has to be transported greater distances? Investigate!

Does your state have gem stones? If so, list them.

FROM: ISOP External Affairs

TO: Routing Below

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Government Document
Ref. 1 ebd 3977-64F

Page 1 of 2

Project Vadar
For Your Eyes Only

ROUTING

White House	**UN Security**
Pentagon	**National Palace**
Prime Minister	**NASA-Cape Canaveral**
NASA-Houston	**Project Team**

Acknowledgement of Receipt ____________

AA Clearance [redacted] and [redacted] punishment as [redacted]

On February 4, astronomers at Kitt Peak Observatory in Arizona accidentally sighted a giant comet about to enter our solar system. The comet was observed and its position carefully plotted over a period of two months. Initial calculations indicated that the comet would pass very, very close to Earth and, in fact, with the estimated experimental errors, a collision with Earth was deemed highly possible. Because of this possibility and because of the apparent size of the comet, North American government officials have declared a **consolidated national emergency** (Priority A-1). Public disclosure is being deferred until a later date.

The gravity of the situation was considered to be sufficient for the North American Alliance governments to provide priority funding for a study of the comet. That study was completed last week. The report states: "We have firmly established that Comet Vadar is on a collision course with Earth. We have also firmly established that the mass and velocity of Vadar are sufficiently large to cause the collision to be fatal. The collision will change the Earth's axis of rotation by more than 2 degrees. At a minimum, this will result in massive tidal waves, extremely high velocity winds and abrupt and severe weather changes. The effect on orbit is unknown. *Collision will occur 227 days from today's date.*

The decision has been made not to inform the peoples of the world of these facts until a well thought out program has been established. (Outstanding psychologists, psychiatrists, members of the clergy, scientists, sociologists, government officials and selected U.N. representatives will draw up the plan.)

In the meantime, the governments of the North American Alliance have decided to undertake a project to colonize Mars. Mars was selected in that it is the closest object now known that can, with some ingenuity, support life as we know it. It was also decided that because of the psychological barriers involved in such a project, both a team of scientists and a team of lay people would be engaged to work on the project. You are gathered here today because you have been selected as members of the lay person team. If you choose to accept that assignment, you are to begin immediately on the first item—the selection of materials and participants for the mission. The world's combined availability of space craft will limit you to sending 10 rockets with two passengers and a payload of 100,000 pounds each.

It has tentatively been determined that the first launching will begin in approximately eight months. All ten rockets are to be launched in a period of time not to exceed one month. Public announcement of the exact nature of this project and of the Earth's situation will be made no less than two weeks after the last rocket is launched and no more than 2 months before Vadar strikes Earth.

Today you are to make preliminary decisions on two critical questions. You will then meet with the scientists and finalize the selections. Final decisions are to be made in two weeks. The NASA ecosystem analysis (attached to this document) will help you in these decisions.

Of utmost importance is the need to establish a sustainable, permanent colony on Mars. There will be no return and opportunities for resupply appear unlikely.

Project Vadar:
A Voyage To Mars

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Page 2 of 2

ROUTING

White House	**UN Security**
Pentagon	**National Palace**
Prime Minister	**NASA-Cape Canaveral**
NASA-Houston	**Project Team**

Acknowledgement of Receipt ——

CONFIDENTIAL

[illegible] Document : Divulging [illegible] information is illegal and considered treasonous, punishment as NAA Class 1 Offense.

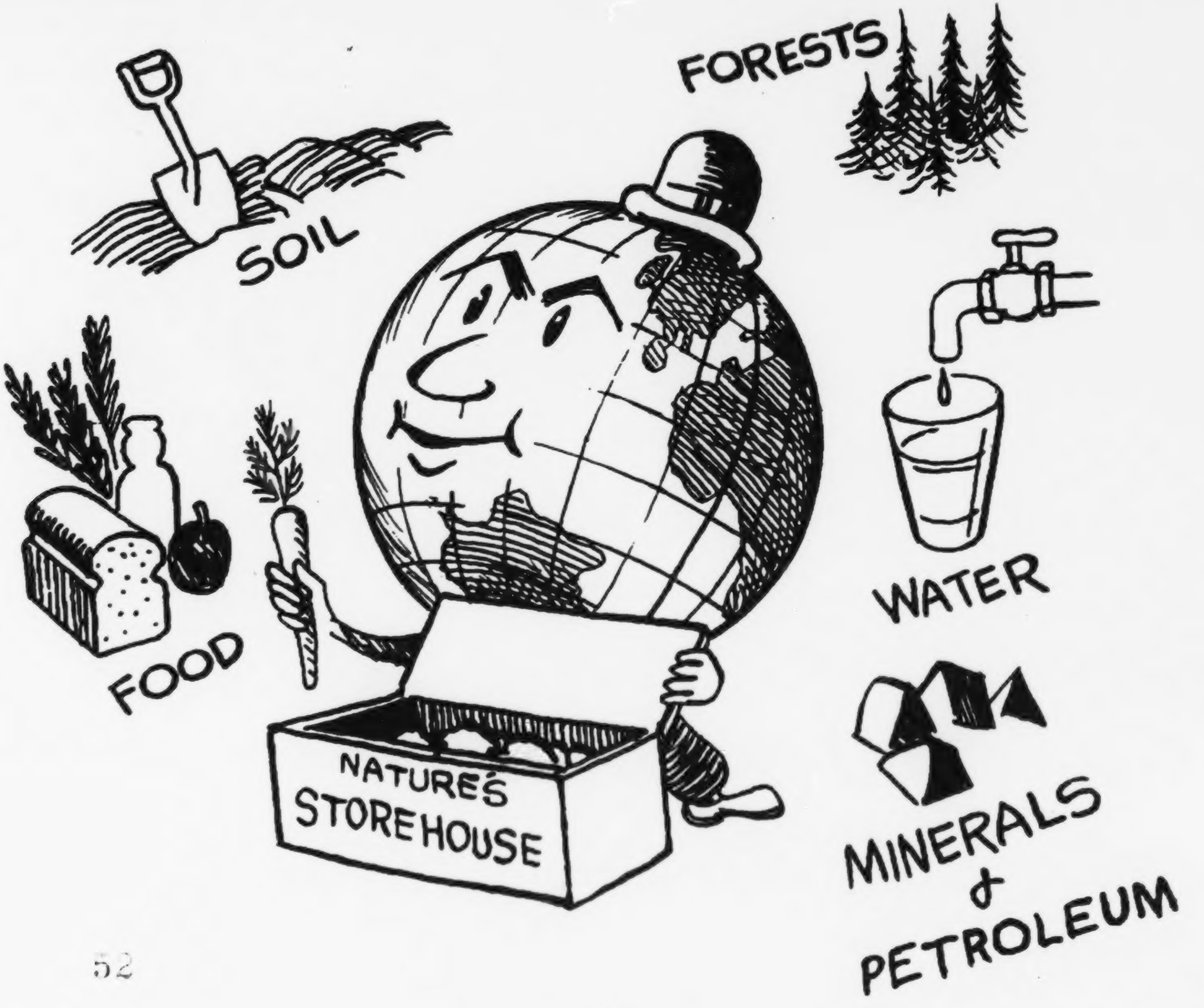
Project Vadar:
A Voyage To Mars

Decision Document

- What skills should be included in the list of the ten who will make the trip?
- What are the ten most important items you will need to bring life from Earth to Mars, and to sustain that life?

Characteristic:	Earth	Mars
EQUATORIAL DIAMETER (EARTH = 1 OR 7,926.4 MILES	1	0.53
MASS (EARTH = 1)	1	0.11
VOLUME (EARTH = 1)	1	0.15
DENSITY (WATER = 1)	5.52	3.95
EQUATORIAL SURFACE GRAVITY (EARTH = 1)	1	0.38
ROTATION ON AXIS (EARTH = 1 day)	1 day	1.03 days
REVOLUTION AROUND SUN (EARTH TIME)	1 year	1.88 years
WATER COVER	71%	No liquid water, but polar ice caps & appears to have ground water.
ATMOSPHERE	78% = N_2, 21% = O_2 1% = CO_2, A & others	95% = CO_2, 3% = N_2 >1% O_2
MAGNETIC FIELD	Yes	Weak
LAND SURFACE	Chiefly Silicates	A typical weathered volcanic soil.
TEMPERATURE	moderate variations min. = -127° F max. = 136° F	At the equator: mostly below zero min. = -150° F max. = 80° F
LIFE	Abundant, many forms, heavily depending on liquid water, and in most cases, oxygen.	Little protection against the sun's radiations that UV would quickly kill any unprotected Earth organisms.
SOLAR INPUT (at surface)	$\simeq 1000 \frac{\text{watts}}{m^2}$	$\simeq 500 \frac{\text{watts}}{m^2}$

From a copyrighted activity of Kendall/Hunt Publishing Company, ***Global Science:Energy, Resources, Environment***


SOIL
FORESTS
FOOD
WATER
NATURE'S
STORE HOUSE
MINERALS
&
PETROLEUM

Everything We Have and Everything We Use Comes From Our Natural Resources

Everything we have and everything we use has to come from somewhere. Suggestions to help your students look closely and learn where things come from. *Understanding the Law of Conservation of Matter*: Matter can be neither created nor destroyed also means you can't make something out of nothing— *Everything Is Made From Something*.

Questions For Students

What Do You Think?

Food

Where do you think your food comes from?

- What do you think it would be like to live on a farm?
- Is it easy to be a farmer? What would you grow?
- What do you think it was like to be a farmer a long time ago?

Clothing

What do you think clothes are made of?

- Do all clothes have a label? What does it say?
- How are your clothes like someone else's? How are they different?
- What would you do to make your clothes better— easier to use, last longer, look better?

Shelter

What do you think your house is made of?

- Where did the materials come from?
- Is there a factory where you live that makes something you have in your house?
- If you were building a house, what would you do first?

Where Do They Come From?

Where do you think the special rocks and minerals come from?

- Can you name any useful rocks you use?
- Are any useful rocks mined near where you live?
- What do you think it was like to be a miner a long time ago?

Virtually every town has a sand and gravel mine (aggregates or stone quarry) nearby to help make the sidewalks, foundations, buildings, and roads we use everyday.

Everything We Have and Everything We Use

Everything is an Animal, Vegetable, or Mineral. Help your students look closely and learn where things come from? *Understanding the Law of Conservation of Matter*: Matter can be neither created nor destroyed also means you can't make something out of nothing—*Everything Is Made From Something*.

Match

Where Things Come From

Food
Clothes
School Building
Your Home
Bicycle
Chair
Television set
Sidewalk
Favorite stuffed animal
Everything else you can name

- Animal
- Vegetable
- Mineral (Special Rocks)

Some things, like your tennis shoes are made of all three.

- *Animal*—leather uppers
- *Vegetable*—cotton shoe lace, maybe a little bit of the rubber sole
- *Mineral*—Almost always the "rubber" sole, the cloth upper part (usually a synthetic), any metal parts (eyelets), the cloth or "fabric" interior is normally synthetic, made from petroleum and other minerals.

Play a game of 20 Questions— Where students find something in the classroom while the other students ask questions to try to identify the object. Then classify each item into one of the three categories of Animal, Vegetable, or Mineral.

Posters As A Teaching Tool— Assign an object (or one of the metals or minerals) to each student to research: Where does it come from? What properties and characteristics does that metal or mineral have that makes it suitable for use in that product? Do you think there is a substitute mineral available? Why, and where does it come from?

Mining At Play
and
Switched On Mining

HINT: Minerals are in every one of the items mentioned in the match, above. Although minerals occur naturally in all foods, sometimes the manufacturer adds extra doses to: supplement its nutritional value (vitamins & minerals); help baked goods (sodium bicarbonate); resist decay (salt and other preservatives); add color (titanium dioxide); etc.

EXAMPLE: Limestone is added to toothpaste, sugar, drinking water, candy bars, and lots more foodstuffs. PLUS limestone is used to make (or is part of) glass, ceramics, carpet, paper, roofing materials, and cement, just to name a few. The Great Pyramid near Cairo, Egypt, was built using 2.3 million blocks of limestone, each weighing about 2.5 tons.

We hope our use of the word vegetable instead of plant doesn't cause confusion for your students.

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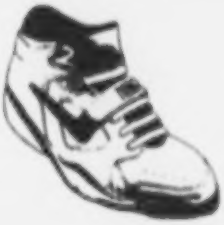
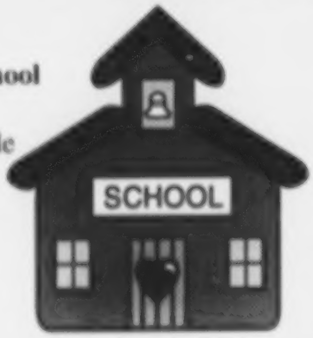
Where Do Things Come From?

Is it Animal?
Is it Vegetable?
Is it Mineral?

Name____

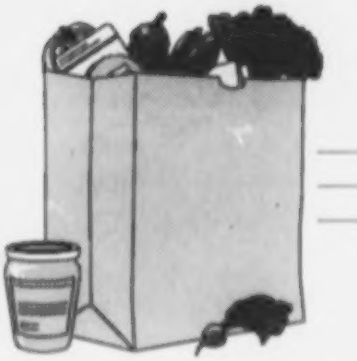


Your Shoes
____Animal
____Vegetable
____Mineral

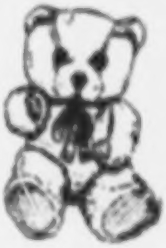


Your School
____Animal
____Vegetable
____Mineral

Animal

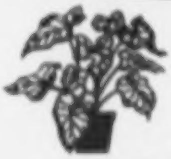


Food
____Animal
____Vegetable
____Mineral



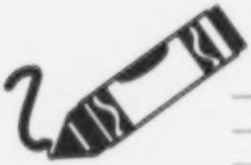
Teddy Bear
____Animal
____Vegetable
____Mineral

Vegetable

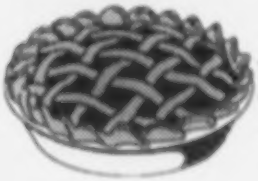


Plant
____Animal
____Vegetable
____Mineral

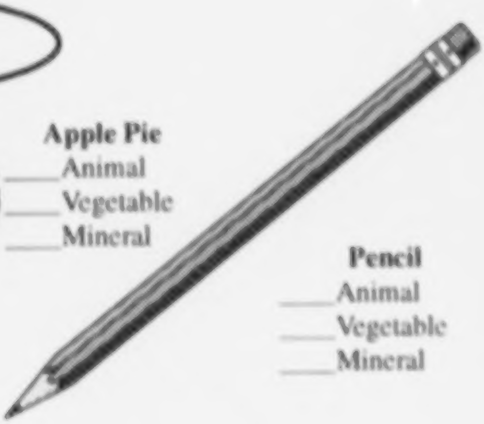
Mineral



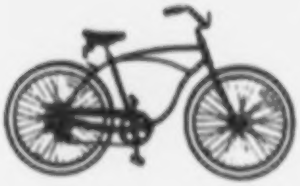
Crayons
____Animal
____Vegetable
____Mineral



Apple Pie
____Animal
____Vegetable
____Mineral



Pencil
____Animal
____Vegetable
____Mineral



Bicycle
____Animal
____Vegetable
____Mineral

Some things can be made of all three—Animal, Vegetable, AND Mineral.
Everything comes from our natural resources.

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475 17th Street #510, Denver, Colorado 80202

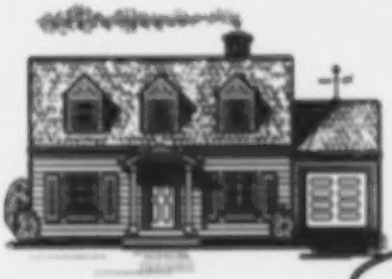
Where Do Things Come From?

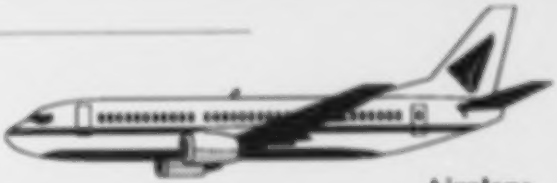
Is it Animal?

Is it Vegetable?

Is it Mineral?

Name________________________________

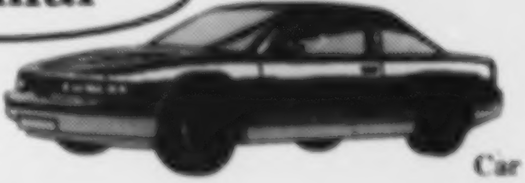




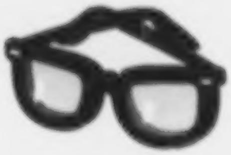
Airplane
____Animal
____Vegetable
____Mineral

Your Home
____Animal
____Vegetable
____Mineral

Animal

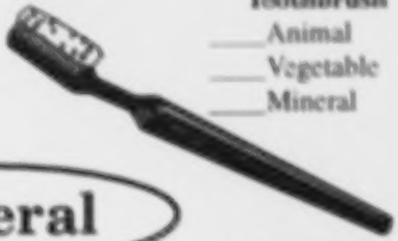


Car
____Animal
____Vegetable
____Mineral

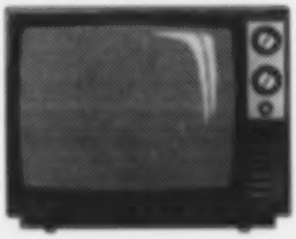


Glasses
____Animal
____Vegetable
____Mineral

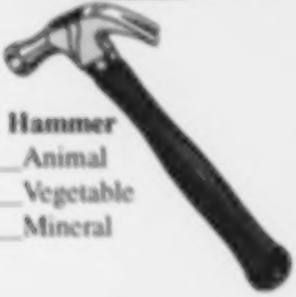
Vegetable



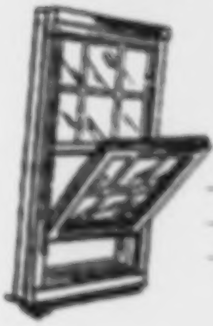
Toothbrush
____Animal
____Vegetable
____Mineral



Mineral



Hammer
____Animal
____Vegetable
____Mineral



Window
____Animal
____Vegetable
____Mineral

Television
____Animal
____Vegetable
____Mineral

Some things can be made of all three—Animal, Vegetable, AND Mineral.

Everything comes from our natural resources.

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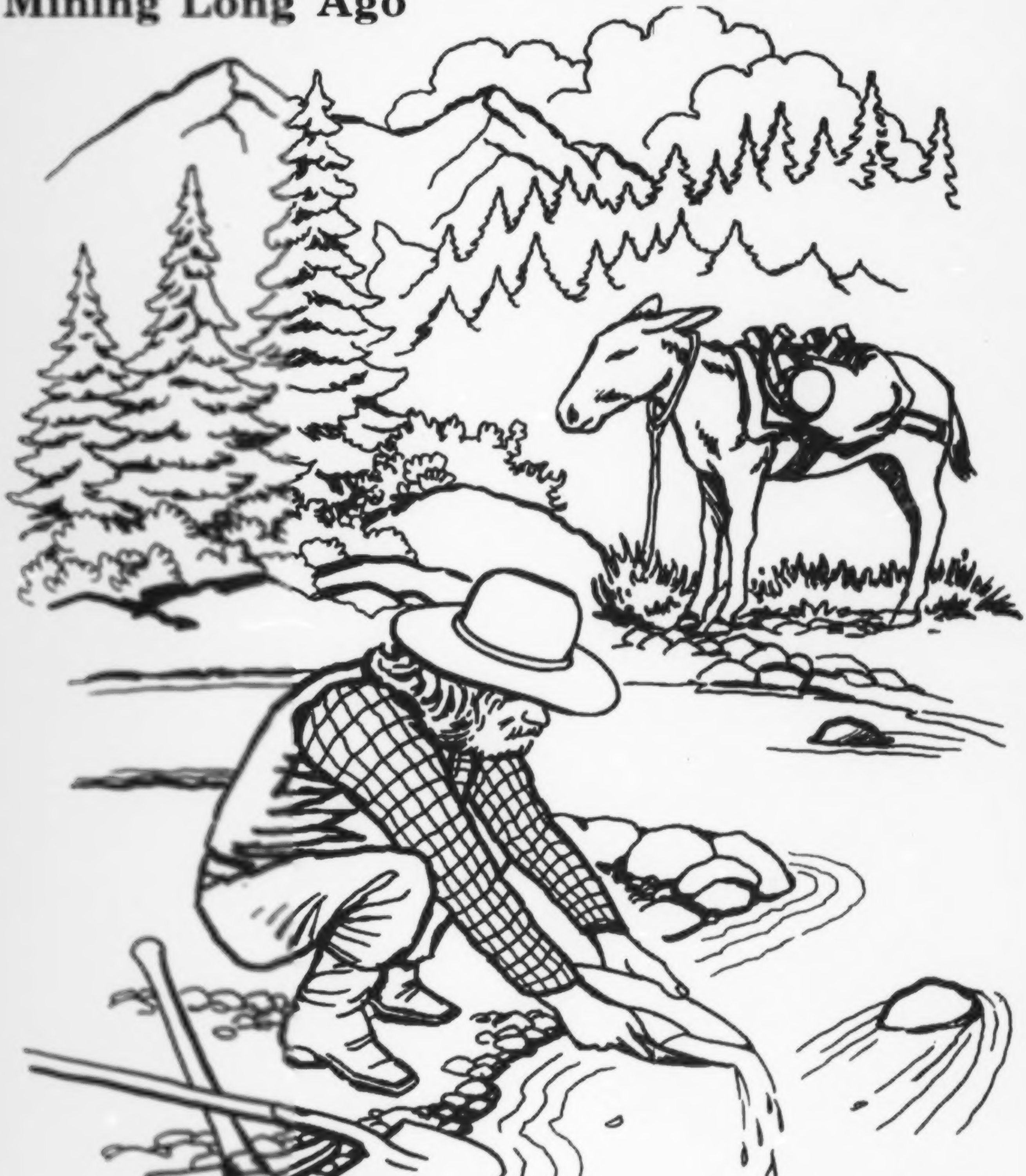
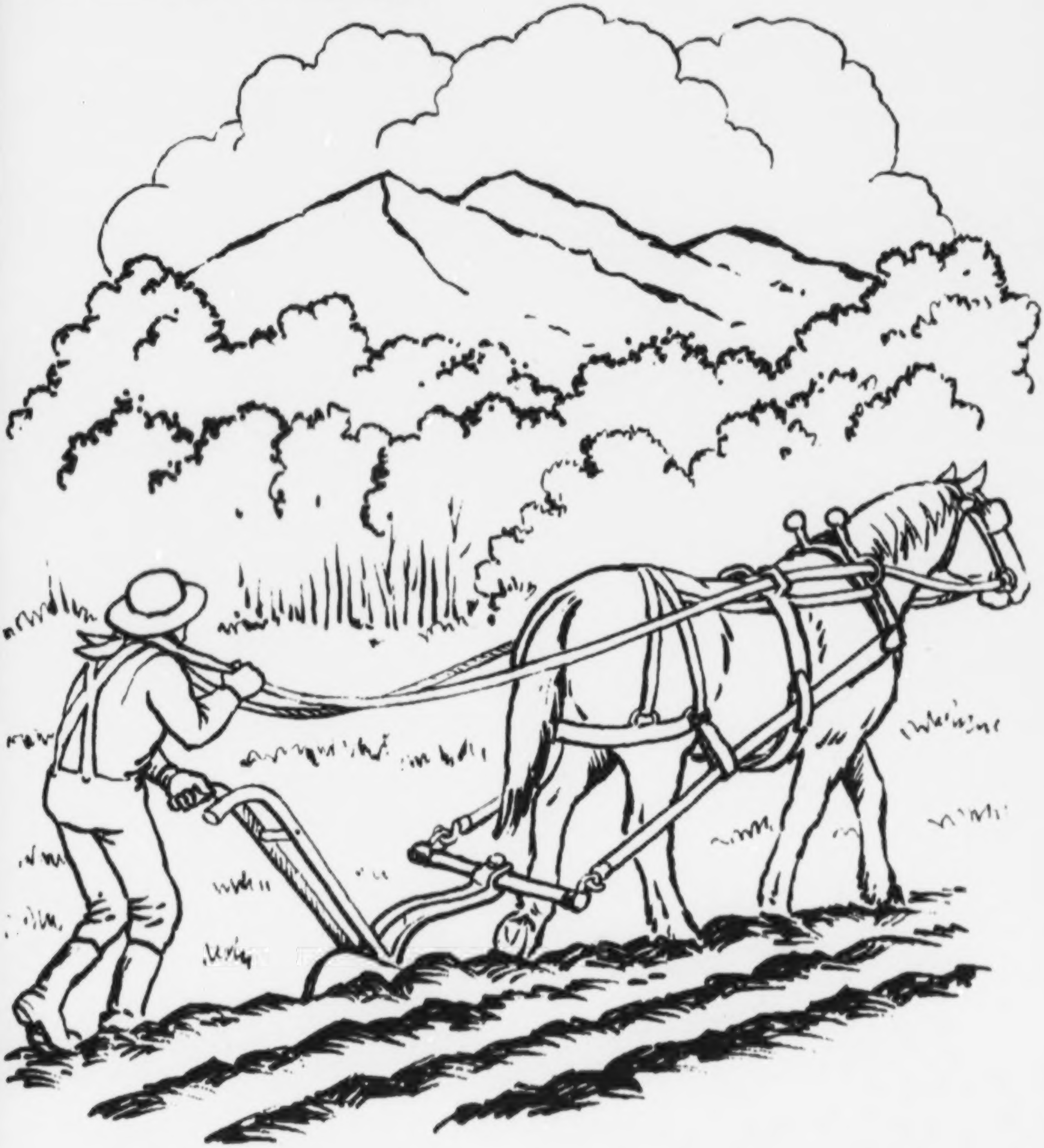
Mining Long Ago



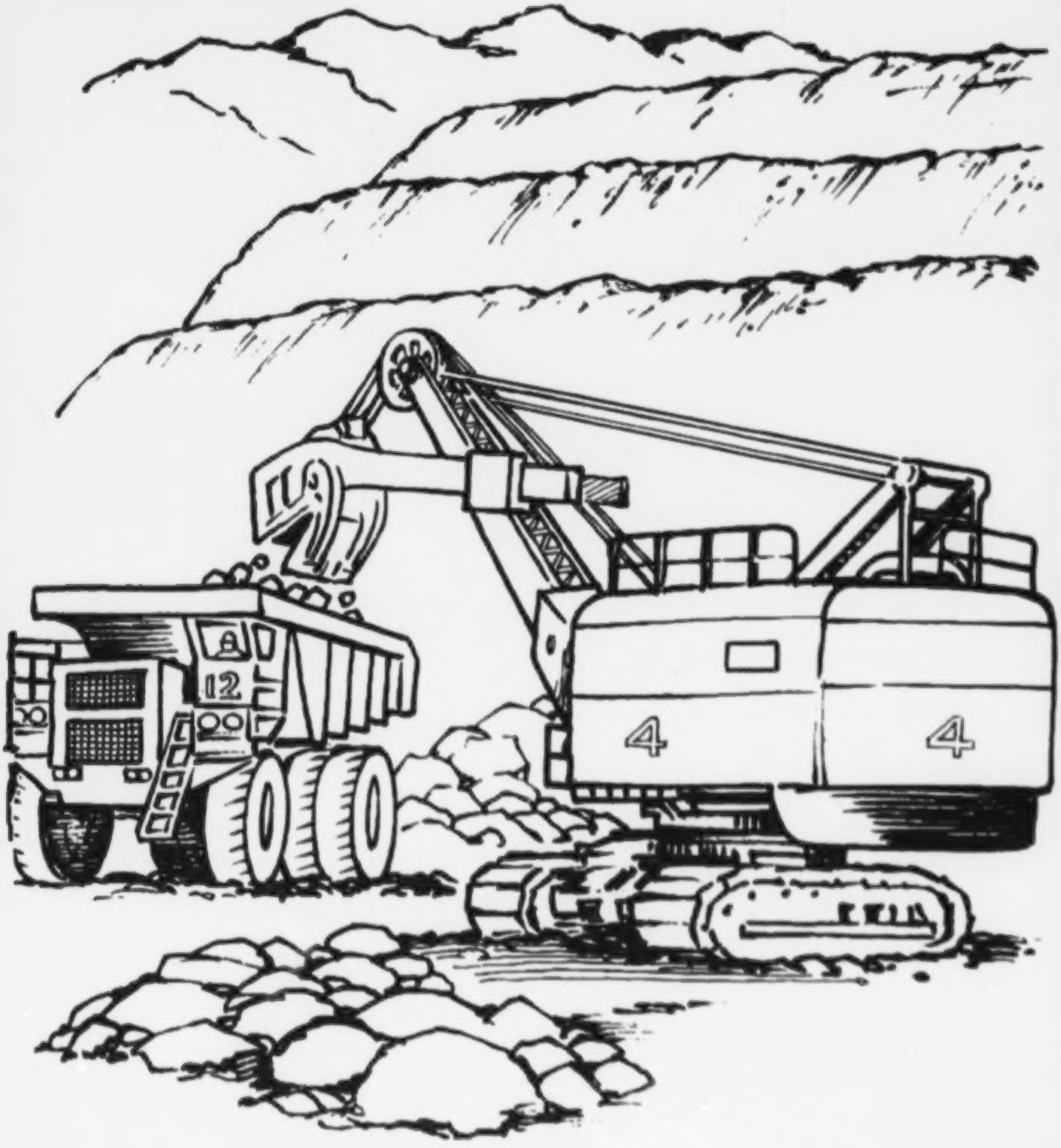
Miners helped to settle much of the Wild West.
His burro was an important tool.

Farming Long Ago



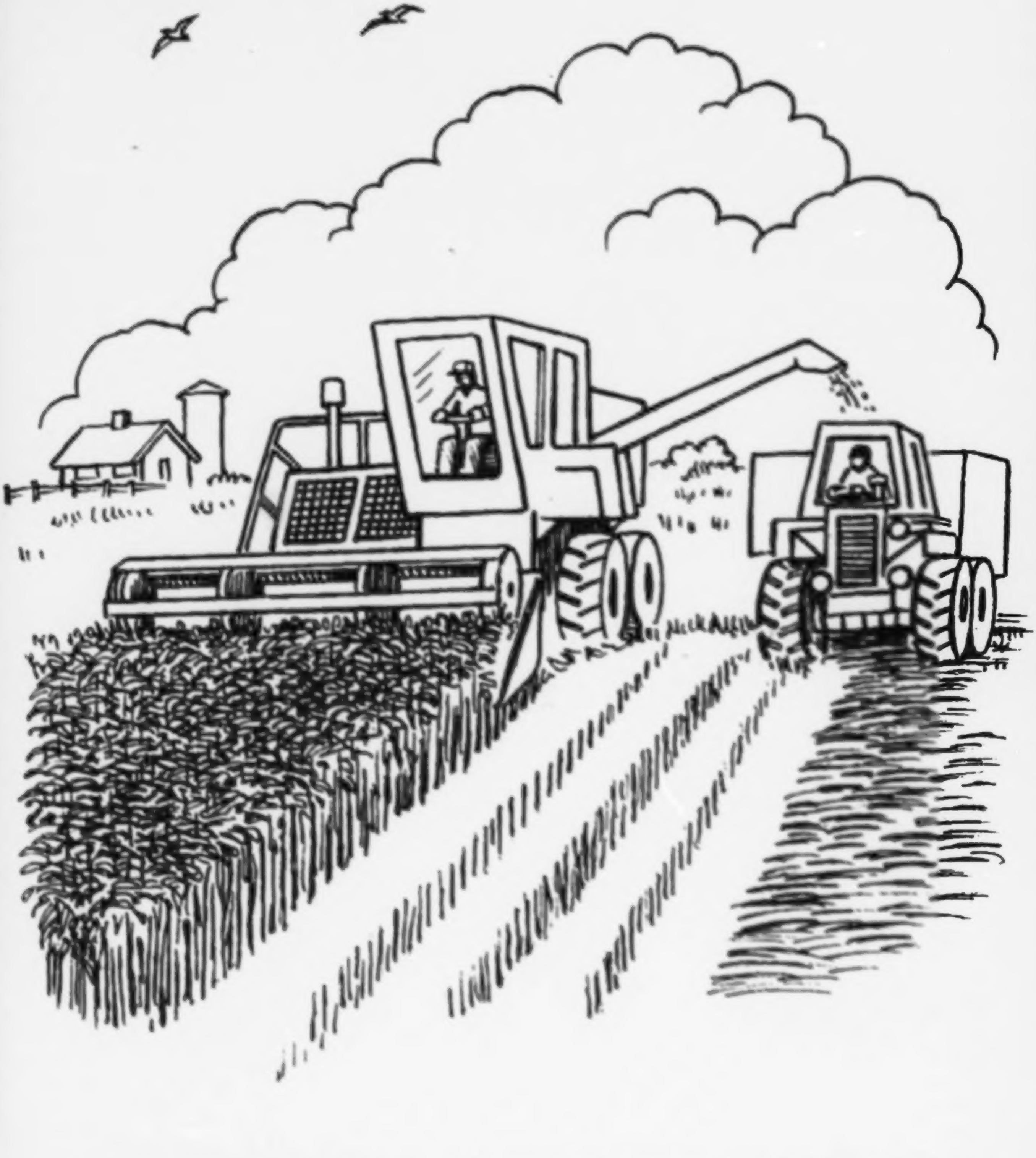
Many people were farmers, who worked hard to grow food for their families.

Mining Today



Most people have never seen a mine, but we all use the things that are made from the special rocks that are dug out of the ground. Do you know what minerals are mined where you live?

Farming Today



Today, farmers use large machines to help grow the food that all of us eat. They are so good at their job, that they can produce food for people all over the world.

NATURAL RESOURCES AND YOUR CHRISTMAS TREE

Adapted from an article by **Doug Jones**, Student, Department of Geosciences, New Mexico Institute of Mining & Technology and **Virginia T. McLemore**, Economic Geologist, New Mexico Bureau of Mines and Mineral Resources

With the excitement of Christmas, the last thing on our minds is the natural resources that bring such pleasure to this holiday season. The lights, decorations, glitter on greeting cards, and wrapping paper add to the excitement of the holidays. Perhaps the image of the Christmas tree is the most memorable of all. Have you ever thought about the raw materials that bring together this image? The majority of these raw materials were furnished by the mining and petroleum industries.

Some people drive to the forest to cut Christmas trees. Most Christmas trees are grown on tree farms. Like all crops, the trees are grown with fertilizers. About half of the world's production of sulfur and over 90% of the production of phosphates and potash go into fertilizers, of which the sampling trees receive a share. Surface and ground water resources are also need for the growth of the trees.

Strands of tiny lights have replaced candles on the trees, adding to the list of minerals that bring holiday-cheer. The wires are made of copper; the insulation and wall plug are formed by the combination of petrochemicals with pumice, limestone, marble, vermiculite, silica, feldspar, or trona. The glass bulbs contain feldspar, silica, clay, nepheline syenite, and trona; filaments in the bulbs are made of thin conductive strips of tungsten metal, which comes from the minerals scheelite and wolframite.

The glittering tree ornaments are made of ingredients similar to light bulbs, and also contain borate and metals such as iron, copper, and lead. The star at the top of the tree could be made from either aluminum, silver, or copper. The ornament hangers and tree stand also are typically a metal alloy containing iron or aluminum. Colorful paints and glazes used to decorate the ornaments are based on petrochemicals, mica or clay, and are pigmented with ingredients such as lithium found in spodumene, titanium in rutile, manganese in pyrolusite, and rare earth elements in bastnesite and monazite. The papers and woods that the paints are applied to commonly contain clay as an additive or filler.

Well over 20 different raw materials are used to create a decorated Christmas tree. And what about the natural resources that go into the gifts, or the electricity to light the tree? WOW! AND, don't forget the steel saw used to cut down your Christmas tree!

Quiz

Listed below are some items often associated with a Christmas tree and some raw materials that are used to make these items. In the blanks write the letters of some of the raw materials used to make each item on the tree. Refer to the Key for some possible answers.

Christmas Tree Items

1. Star____________________

2. Tree____________________

3. Ornament hangers____________________

4. Electrical wire____________________

5. Light bulbs____________________

6. Wire insulation____________________

7. Ceramic Ornaments____________________

8. Plastic ornaments____________________

9. Electricity____________________

10. Glass ornaments____________________

11. Paint____________________

12. Tree Stand____________________

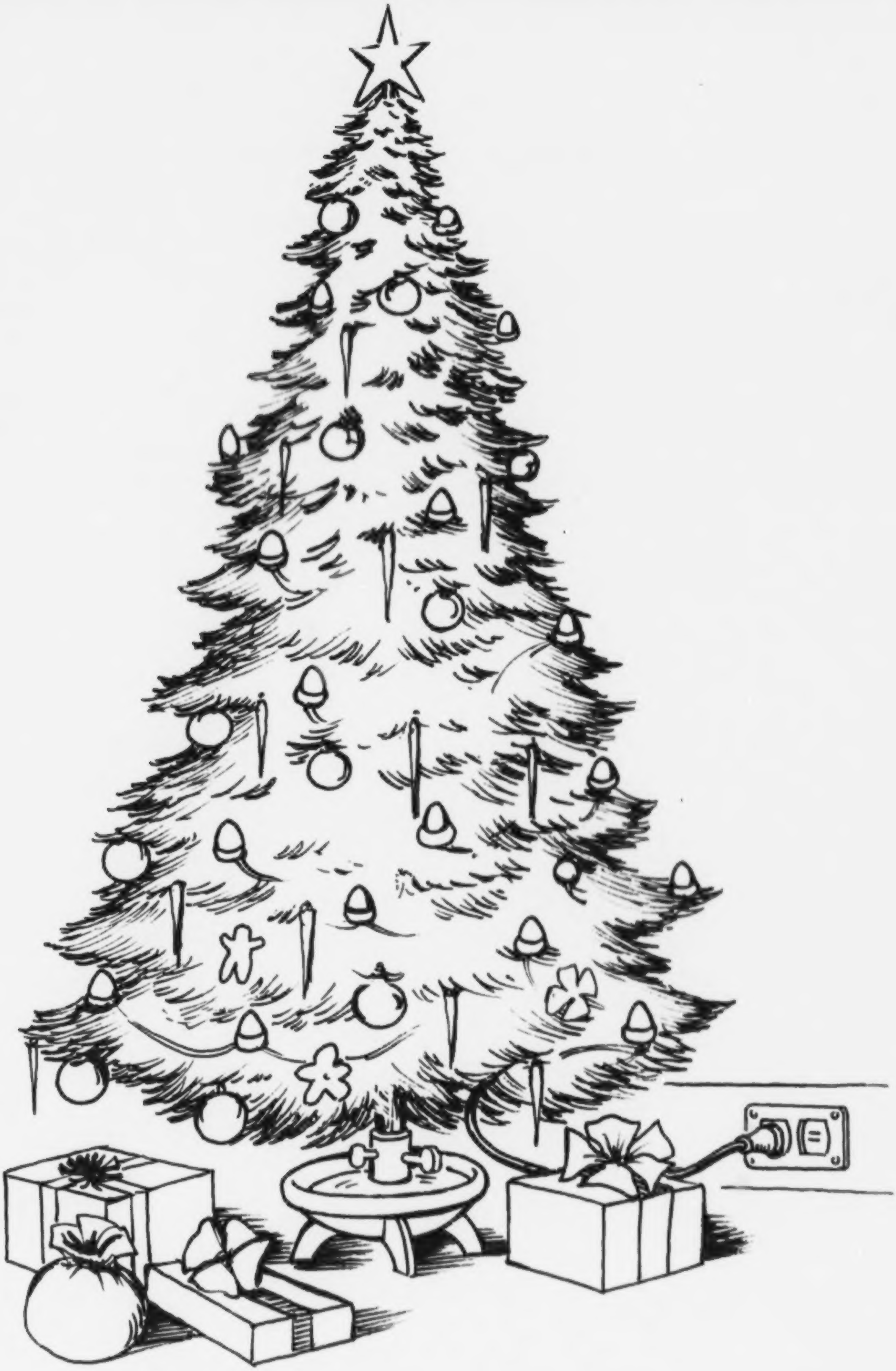
Raw Materials

a. Sulfur
b. Trona
c. Lead
d. Mica
e. Petrochemicals, oil, natural gas
f. Aluminum
g. Potash
h. Iron
i. Silica
j. Vermiculite
k. Clays
l. Silver
m. Manganese
n. Pumice
o. Nepheline syenite
p. Limestone
q. Copper
r. Phosphates
s. Lithium
t. Titanium
u. Rare-earth elements
v. Tungsten
w. Wood
x. Feldspar
y. Coal
z. Water

Key:

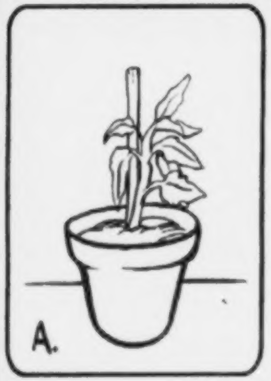
1. Star: f, l, q
2. Tree: a, g, r, w, z
3. Ornament hangers: f, h
4. Electrical wire: q
5. Light bulbs: x, i, k, o, b, v
6. Wire insulation: e, n, p, w, j, x, b
7. Ceramic Ornaments: x, i, k, o, b, h, q, c
8. Plastic ornaments: e
9. Electricity: e, y, z
10. Glass ornaments: x, i, o, b, h, q, c
11. Paint: e, d, k, s, t, m, u
12. Tree Stand: h, f

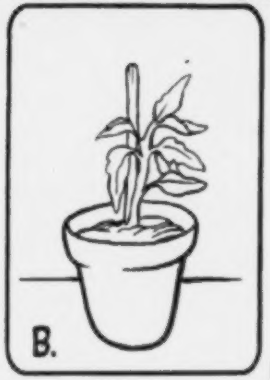
From: *Lite Geology* (Winter, 1992), an earth science magazine of the New Mexico Bureau of Mines and Mineral Resources.

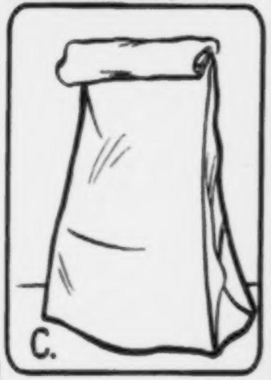


LET'S DO AN EXPERIMENT!

LET'S SEE WHAT HAPPENS TO PLANTS WHEN THEY DO NOT HAVE FOOD AND SUNLIGHT.


A.


B.

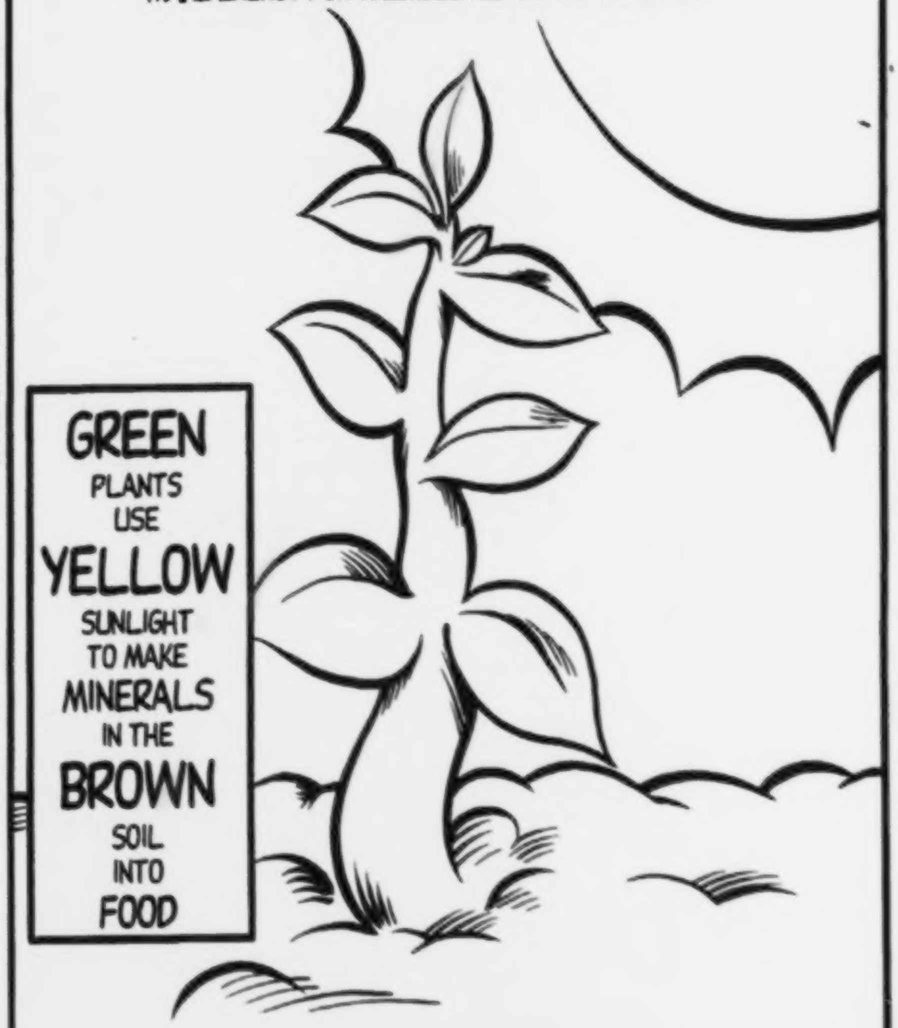

C.

☐ DISTILLED WATER	☐ TAP WATER	☐ TAP WATER
☐ SAND	☐ GOOD SOIL	☐ SAND
☐ SUNLIGHT	☐ SUNLIGHT	☐ NO SUNLIGHT
DAY 1 ☺ 😐 ☹	DAY 1 ☺ 😐 ☹	DAY 1 ☺ 😐 ☹
DAY 4 ☺ 😐 ☹	DAY 4 ☺ 😐 ☹	DAY 4 ☺ 😐 ☹
DAY 7 ☺ 😐 ☹	DAY 7 ☺ 😐 ☹	DAY 7 ☺ 😐 ☹
DAY 11 ☺ 😐 ☹	DAY 11 ☺ 😐 ☹	DAY 11 ☺ 😐 ☹
DAY 14 ☺ 😐 ☹	D ☺ 😐 ☹	DAY 14 ☺ 😐 ☹

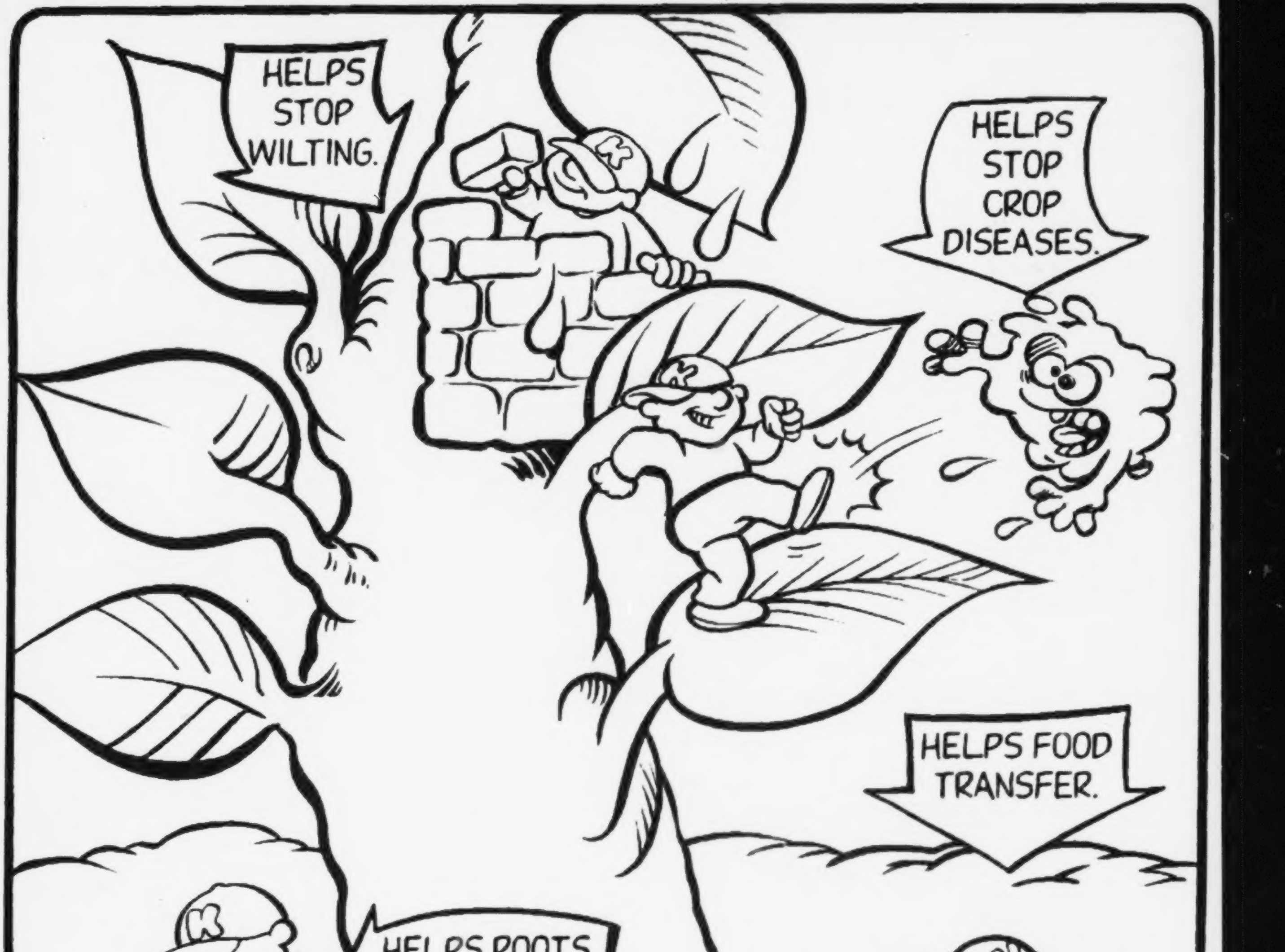
FUN WITH THE PLANT NUTRIENT TEAM, from the Potash & Phosphate Institute

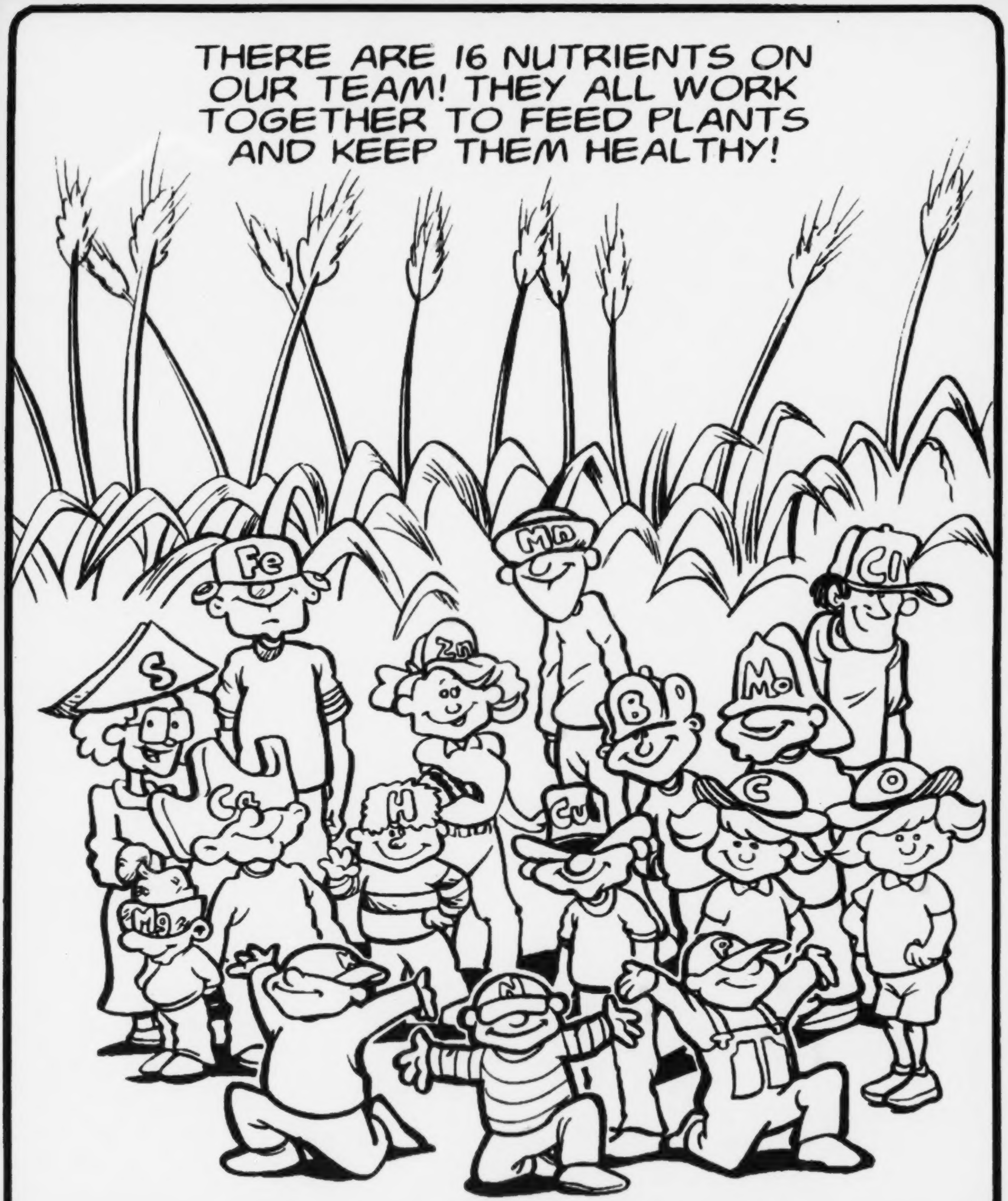
PHOTOSYNTHESIS

PHOTOSYNTHESIS IS THE WAY PLANTS USE SUNLIGHT TO MAKE ENERGY FOR THEMSELVES SO THEY CAN GROW.



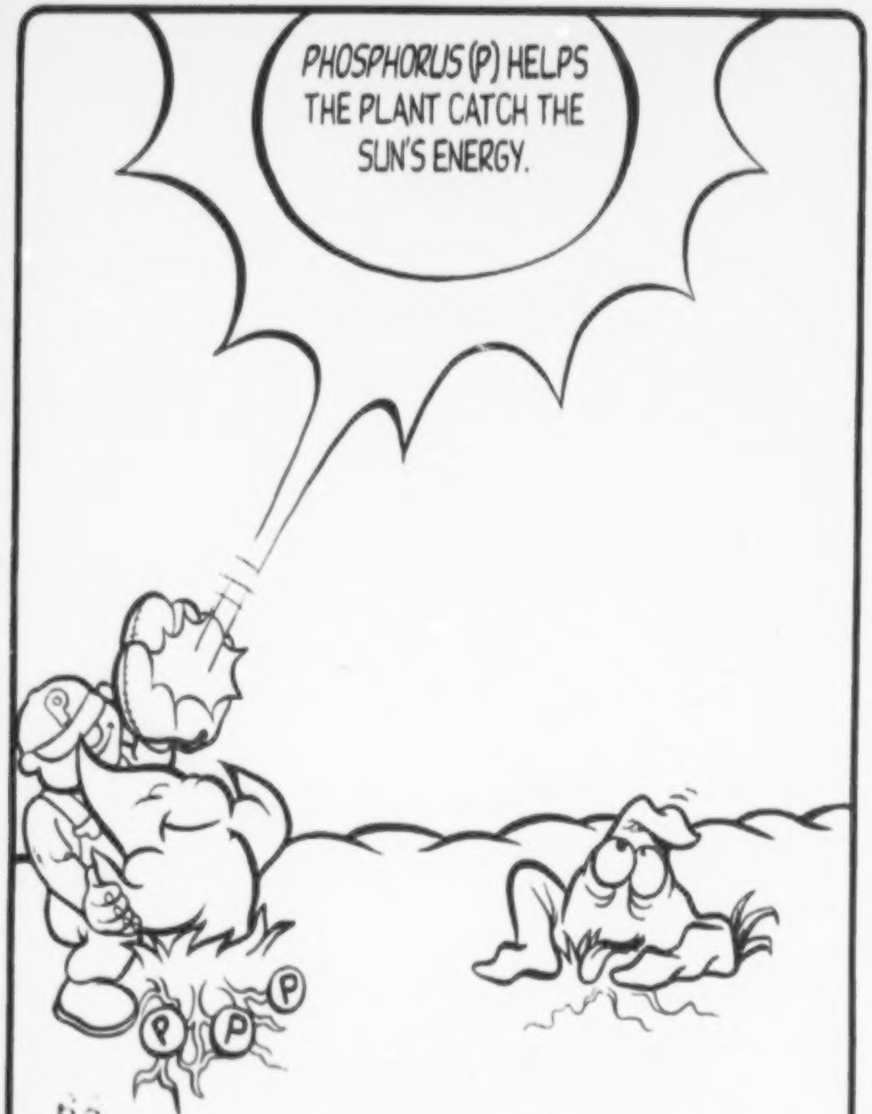
GREEN
PLANTS
USE
YELLOW
SUNLIGHT
TO MAKE
MINERALS
IN THE
BROWN
SOIL
INTO
FOOD


HELPS STOP WILTING.
HELPS STOP CROP DISEASES.
HELPS FOOD TRANSFER.
HELPS ROOTS STAY IN PLACE.
POTASSIUM (THAT'S ME) HAS MANY JOBS TO DO!


THERE ARE 16 NUTRIENTS ON OUR TEAM! THEY ALL WORK TOGETHER TO FEED PLANTS AND KEEP THEM HEALTHY!
Fe
Mn
Cl
S
Zn
B
Mo
Ca
H
Cu
C
O
Mg
N
P

• BORON • CALCIUM • CARBON • CHLORINE • COPPER • HYDROGEN • IRON • MAGNESIUM • MANGANESE • MOLYBDENUM • OXYGEN • SULFUR • ZINC •

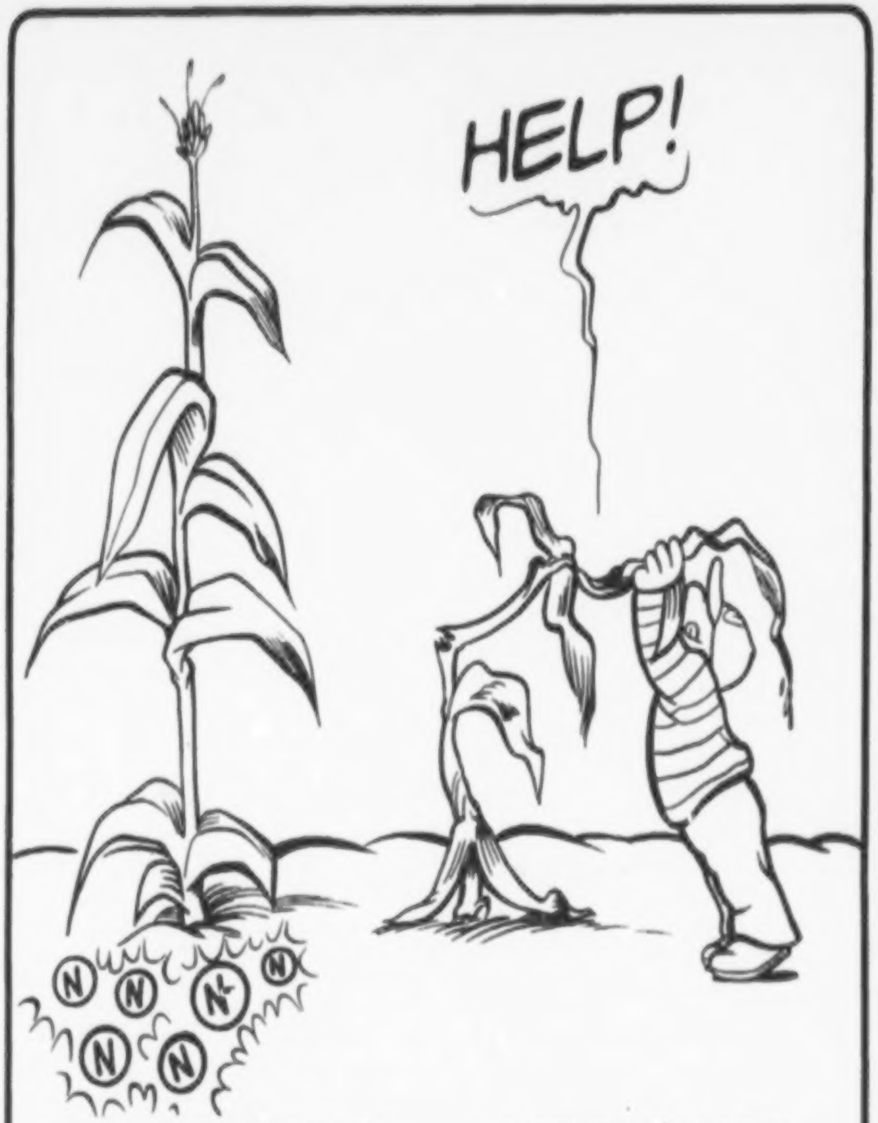
FUN WITH THE PLANT NUTRIENT TEAM, from the Potash & Phosphate Institute


PHOSPHORUS (P) HELPS THE PLANT CATCH THE SUN'S ENERGY.
P
P
P
P

65

PLANTS NEED P FOR HEALTHY ROOTS

FUN WITH THE PLANT NUTRIENT TEAM, from the Potash & Phosphate Institute


HELP!
N
N
N
N
N
N

CORN AND OTHER PLANTS NEED *NITROGEN* (N) TO BE GREEN AND HEALTHY.

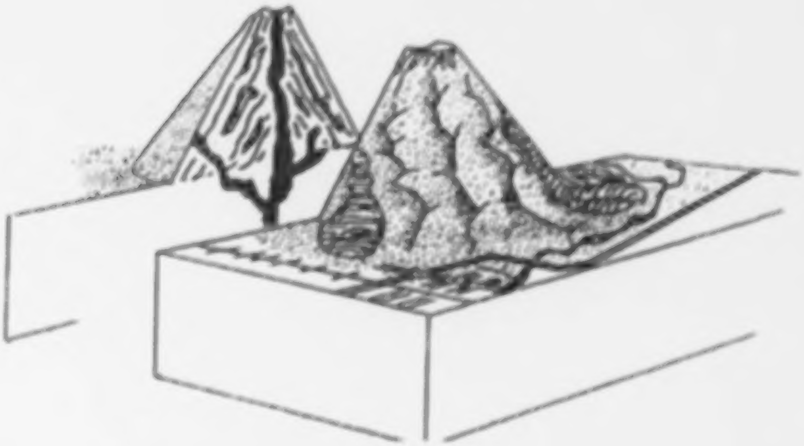
WITHOUT N, PLANTS ARE WEAK AND LOOK YELLOW.

69

MAKE YOUR OWN PAPER MODEL OF A Volcano

Description

This model is intended to help students and other to visualize a stratovolcano (inside and out) and to learn some of the terms used by geologists in describing it. By constructing and examining the model, students will obtain a greater appreciation of the relationship between the internal structure of the volcano and its exterior shape and features. This exercise may give the student and insight as to how a stratovolcano is formed.



Guide

The model represents a *stratovolcano*, or *composite volcano*. It is the most common type of volcano on Earth. Scientists classify volcanoes into three main types: cinder cones, shield volcanoes, and stratovolcanoes.

Cinder Cone

Cinder cones are the smallest and are formed largely by the piling up of *ash*, *cinders* and *rocks*, all of which are called *pyroclastic* ("fire-broken") material, that have been explosively erupted from the *vent* of the volcano. As the material falls back to the ground, it generally piles up to form symmetrical, steep-sided cone around the vent. Sunset Crater in Arizona and Paricutin in Mexico are well-known examples of cinder cones.

Shield Volcano

Shield volcanoes are generally not explosive and are built by the accumulation of very fluid *lava* flows that spread out to produce a mountain with broad, gentle slopes. Shield volcanoes are the largest of all volcanoes, up to tens of kilometers across and thousands of meters high. Kilauea and Mauna Loa Volcanoes in Hawaii are classic examples of active shield volcanoes.

Stratovolcano

A *stratovolcano* is built of lava flows interlayered with pyroclastic material; scientists believe that the layering represents a history of alternating explosive and quiet eruptions. Young stratovolcanoes are typically steep sided and symmetrically cone shaped. There are several active stratovolcanoes in North America. Since 1980 Mount Saint Helens in Washington has become the most familiar. Other well known stratovolcanoes in the United States include Mount Rainier, Mount Shasta, M. Mazama (Crater Lake), and Redoubt Volcano in Alaska. Mount Fuji in Japan and Mount Vesuvius in Italy are other famous stratovolcanoes.

Questions for Further Study

1. Name some other stratovolcanoes and their locations around the world.
2. On the paper model, a small town has been built at the foot of the volcano. This is a common situation around the world. What are some of the problems or hazards the townspeople might have to face living so close to a volcano? Discuss possible solutions to these problems with your class.
3. What types of rocks are associated with each of the three types of volcanoes discussed above?
4. What is another word for the "hole", or vent, in the top of the volcano?
5. Where is the main vent of the paper model volcano? Can you find a second vent drawn on the side of the model volcano?
6. Why are most volcanoes on Earth cone-shaped?

Vocabulary

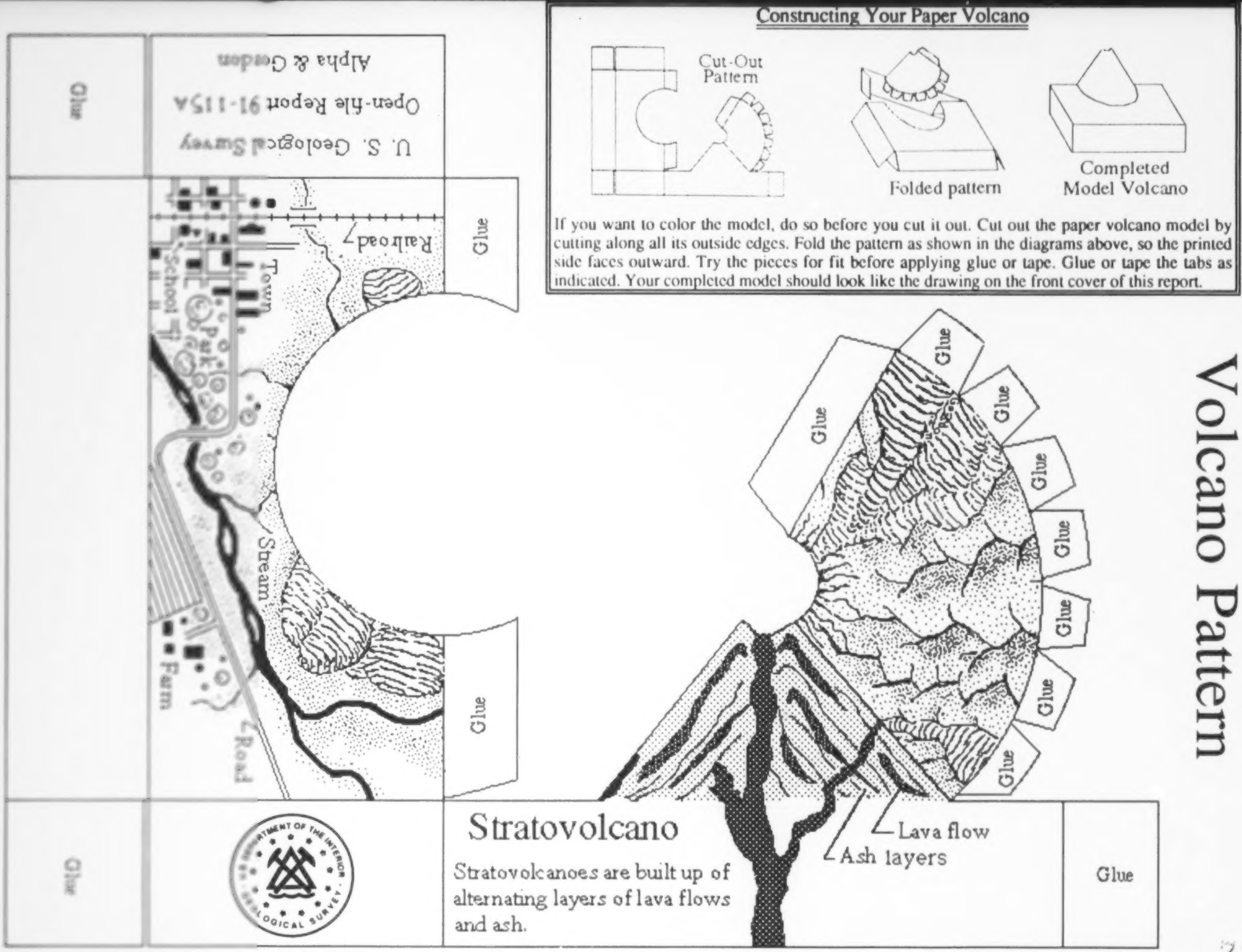
ash
lava
vent
cinders
cinder cone
eruption
stratovolcano
shield volcano
composite volcano
volcanic hazards
pyroclastic
crater

Volcano Pattern

Constructing Your Paper Volcano

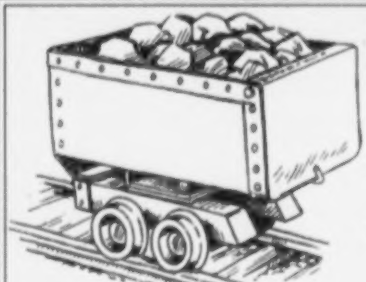
Cut-Out Pattern
Folded pattern
Completed Model Volcano

If you want to color the model, do so before you cut it out. Cut out the paper volcano model by cutting along all its outside edges. Fold the pattern as shown in the diagrams above, so the printed side faces outward. Try the pieces for fit before applying glue or tape. Glue or tape the tabs as indicated. Your completed model should look like the drawing on the front cover of this report.


Glue
U. S. Geological Survey
Open-file Report 91-115A
Alpha & Gordon
Glue
Railroad
Town
School
Park
Stream
Farm
Road
Glue
Glue
Glue
Glue
Glue
Glue
Glue
Glue
Glue
Glue
Glue
Lava flow
Ash layers

Stratovolcano

Stratovolcanoes are built up of alternating layers of lava flows and ash.



Sources For More Information

The Mineral Information Institute (MII) has been providing quality educational materials since 1980. With the active involvement of educators, scientists, and engineers, the Institute strives to provide free and low cost materials that are accurate and balanced.

In addition to the materials provided by MII, numerous other organizations produce and share quality programs to help classroom teachers. This guide provides a brief selection of those sources.

Dedicated to Developing Our Greatest Natural Resource
Our Children

The world of rocks and minerals is fascinating, and our goal (along with the other organizations mentioned in this guide) is to help you present that world to your students. We hope you will share this reference guide, and any other materials you have received from MII, with your fellow teachers.

MII is continually producing new and updated materials, and reviewing the programs of others, to provide the best mix of usable, relevant teaching aides at no cost to teachers. With the exception of our work with Kendall/Hunt Publishing Company and author John Christensen in the high school science program, *Global Science: Energy, Resources, Environment* (a one to two year, integrated environmental science curriculum), our materials are intended as supplements to help teachers fill the gaps that exist in many texts.

MII sells its materials to individuals and organizations so those same materials can be provided free to teachers. Contributions also help the Institute provide materials at no (or low) cost.

What's Currently Free For Teachers From MII

- *A Study of The Earth and All It Provides* (48-page book) providing fully integrated activities, lessons, and backgrounds for grades K-8, plus a few of the best high school-level challenges that exist.
- Selection of videos on minerals and natural resources (yours to keep for the cost of shipping-$3 each).
- Posters-from the simple to the complex-
    - *If It Can't Be Grown, It Has To Be Mined* reinforcing that everything comes from our natural resources.
    - *From The Earth. . . A Better Life* showing that perhaps our most limited resource is usable land, and how we are using it today.
    - *Elements Comprising the Human Body*, a health and nutrition poster showing that even people are made of those same minerals and elements that make everything else, plus why we need them for life and how we eat them everyday.
    - *Look Around, Everything Is Made of Something* demonstrating the variety, quantity, and function of the different natural resources that are used to build our homes, as well as maps that show where in America the mineral resources come from.
- Special for Primary Grades. 16 pages of natural resource awareness and appreciation activity and coloring pages. Emphasizing plant growth, geography, observing, identification, and inquiry of the world around us.
- The latest offering of learning supplements from professional organizations and societies similar to MII.
- Occasionally, generous sponsors provide new wall-size posters of minerals, crystals, gems and other materials that we can provide free, while supplies last.
- Monthly column in *Teaching PreK-8* magazine (circ. 150,000) offering the best and most up-to-date activities and tips for incorporating mineral resource information into your already full schedule.

Plus

√ answers to questions,
√ access to classroom speakers,
√ tips on developing mentors for tours,
√ more free materials and how to get them,
√ references to experts and other sources.

If you'd like to **Dig A Little Deeper** into Earth's buried treasures, we'd be proud to help.

MINERAL INFORMATION INSTITUTE

475 17th Street, Suite 510
Denver, Colorado 80202
303/297-3226

The Mineral Information Institute is pleased to present this free guide to help you find other sources for useful and accurate information about the importance of minerals to our society.

ORGANIZATIONS
That Can Be Contacted For Further Information

Note: This listing is not all inclusive of organizations dealing with metals, minerla, energy, and other natural resources.
See: *Encyclopedia of Associations*, Gale Research Inc., published annually.

Alaska Miners Association
501 W. Northern Lights Boulevard
Suite 203
Anchorage, Alaska 99503-2565
Phone: (907) 276-0347

The Aluminum Association
900 19th Street, N.W.
Washington, D.C. 20006
Phone: (202) 862-5100

American Association of Professional Geologists
7828 Vance Drive, Suite 103
Arvada, Colorado 80003
Phone: (303) 431-0831

American Coal Foundation
1130 17th Street, N.W., Suite 220
Washington, D.C. 20036
Phone: (202) 466-8630

American Geological Institute (See page 10)

American Mining Congress (See page 10)

American Society for Surface Mining and Reclamation
21 Grandview Drive
Princeton, West Virginia 24740-2026
Phone: (304) 425-8332

American Zinc Association
1112 16th Street, N.W., Suite 240
Washington, D.C. 20036
Phone: (202) 835-0164

Arizona Mining Association
2701 North 3rd Street, Suite 2015
Phoenix, Arizona 85004
Phone: (602) 266-4416

Asbestos Information Association/North America
1745 Jefferson Davis Highway, Suite 509
Arlington, Virginia 22202
Phone: (703) 979-1150

British Columbia and Yukon Chamber of Mines
840 West Hastings Street
Vancouver, British Columbia V6C 1C8 CANADA
Phone: (604) 681-5328

Building Stone Institute
P.O. Box 5047
White Plains, New York 10602-5047
Phone: (914) 232-5725

Cadmium Council, Inc.
12110 Sunset Hills Road, #110
Reston, Virginia 22090
Phone: (703) 709-1400

California Mining Association
One Capitol Mall, Suite 220
Sacramento, California 95814
Phone: (916) 447-1977

Canadian Institute of Mining, Metallurgy and Petroleum
Suite 1210, Xerox Tower
3400 de Maisonneuve Boulevard West
Montreal, Quebec H3Z 3B8 CANADA
Phone: (514) 939-2710

Chamber of Mines of Eastern British Columbia
215 Hall Street
Nelson, British Columbia V1L 5X4 CANADA
Phone: (604) 352-5242

Chamber of Mineral Resources of Nova Scotia
202 - 5525 Artillery Place
Halifax, Nova Scotia
CANADA B3J 1J2
Phone (902) 422-5806

Copper Development Association
260 Madison Avenue
New York, New York 10016
Phone: (212) 251-7200

Geological Society of America (See page 10)

Geothermal Resources Council
2001 2nd Street, Suite 5
P.O. Box 1350
Davis, California 95617
Phone: (916) 758-2360

Gold and Silver Institute, The
1112 16th Street, N.W., Suite 240 Washington, D.C. 20036
Phone: (202) 835-0185

Gypsum Association
810 1st Street, N.E., Suite 510
Washington, D.C. 20002
Phone: (202) 289-5440

Idaho Mining Association
P.O. Box 1660
Boise, Idaho 83701
Phone: (208) 342-0031

Indiana Limestone Institute
Stone City Bank Building, Suite 400
Bedford, Indiana 47421
Phone: (812) 275-4426

International Magnesium Association
1303 Vincent Place, Suite 2
McLean Virginia 22102
Phone: (703) 442-8882

Lead Industries Association
295 Madison Avenue
New York, New York 10017
Phone: (212) 578-4750

Marble Institute of America
33505 State Street
Farmington, Michigan 48335
Phone: (313) 476-5558

Mining Association of Canada
1105-350 Sparks Street
Ottawa, Ontario K1R 7S8 CANADA
Phone: (613) 233-9391

Mining Association of Manitoba
700 - 305 Broadway
Winnipeg, Manitoba
CANADA R3C 3J7
Phone (204) 942-2789

Mining Industry Council of Missouri
101 East High Street, Suite 200
P.O. Box 725
Jefferson City, Missouri 65102
Phone: (314) 635-7308

Montana Mining Association
2301 Colonial Drive
Helena, Montana 59601
Phone: (406) 433-7297

National Aggregates Association
900 Spring Street
Silver Spring, Maryland 20910
Phone: (301) 587-1400

National Building Granite Quarries Association
P.O. Box 482
Barre, Vermont 05641
Phone: (802) 476-3115

National Quartz Producers Council
P.O. Box 1719
Wheat Ridge, Colorado 80034
Phone: (303) 430-1307

National Stone Association
1415 Elliot Place, N.W.
Washington, D.C. 20007
Phone: (202) 342-1100; 1 (800) 342-1415

Northwest Mining Association
10 North Post Street, Suite 414
Spokane, Washington 99201
Phone: (509) 624-1158

Northwest Territories Chamber of Mines
P.O. Box 2818
Yellowknife, Northwest Territories
CANADA X1A 2R1
Phone (403) 873-5281

Ontario Mining Association
1501 - 110 Yonge Street
Toronto, Ontario
CANADA M5C 1T4
Phone (416) 364-9301

Perlite Institute
88 New Dorp Plaza
Staten Island, New York 10306
Phone: (718) 351-5723

Potash and Phosphate Institute
655 Engineering Drive
Norcross, Georgia 30092
Phone: (404) 447-0335

Quebec Metal Mining Association
942 - 2635 Hochelaga Boulevard
Saint Foy, Quebec
CANADA G1V 4W2
Phone (418) 657-2016

Salt Institute
Fairfax Plaza, Suite 600
700 North Fairfax
Alexandria, Virginia 22314-2040
Phone: (703) 549-4648

Saskatchewan Mining Assn. Inc.
1740 Avord Tower
Regina, Saskatchewan
CANADA S4P 0R7
Phone (306) 757-9505

Silver Users Association
1730 M Street, N.W., Suite 911
Washington, D.C. 20036
Phone: (202) 785-3050

Tin Research Institute
1353 Perry Street
Columbus, Ohio 43201
Phone: (614) 424-6200

Titanium Development Association
11 West Monument Avenue, Suite 510
Dayton, Ohio 45401
Phone: (513) 223-8431

U.S. Council for Energy Awareness
1776 I Street, N.W., Suite 400
Washington, D.C. 20006-3708
Phone: (202) 293-0770

Western States Public Lands Coalition
P.O. Box 8345
Pueblo, Colorado 81008
Phone: (719) 543-8421

Women in Mining National
1801 Broadway, Suite 400
Denver, Colorado 80202
Phone (303) 298-1535
Has chapters in various states.

Wyoming Mining Association
1700 West Lincolnway
P.O. Box 866
Cheyenne, Wyoming 82003
Phone: (307) 635-0331

Yukon Chamber of Mines
P.O. Box 4427
Whitehorse, Yukon Territory Y1A 3T5 CANADA
Phone: (403) 667-2090

NOTE: **Association For Women Geoscientists** is a professional organization that has no information available for students K-12. Young women can keep this affiliation in mind if they decide on a career in the geosciences.

The Northwest Mining Association has a 10-page listing of educational materials available from them or other sources. Program descriptions, addresses, and costs (if any) are provided.

NWMA

See *Mighty Minerals* (page 4).
Be sure to write on school letterhead.

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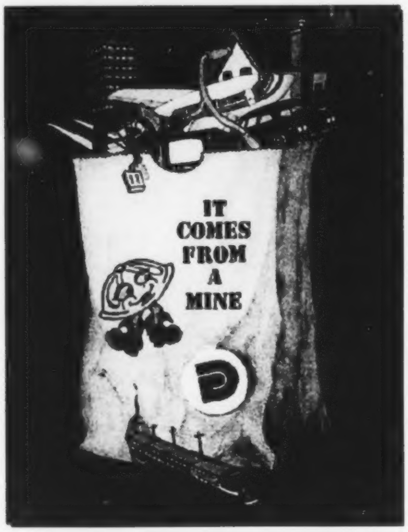
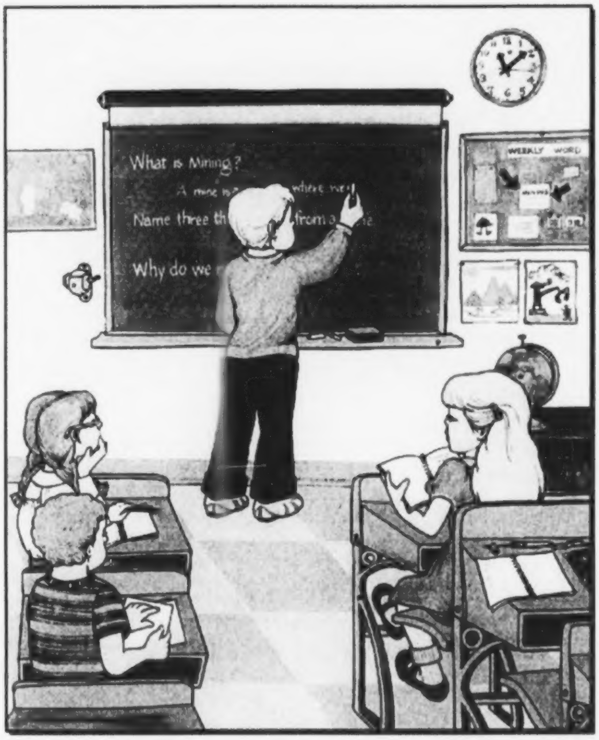
BEST COPY AVAILABLE

A delightful smiling hard-hat with legs and boots serves as a guide to the next two booklets:

IT COMES FROM A MINE

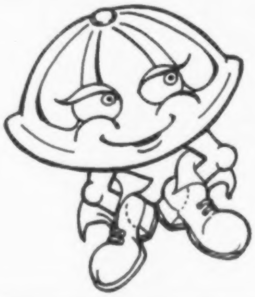
A colorful booklet with activities, games, *word search*, and more!

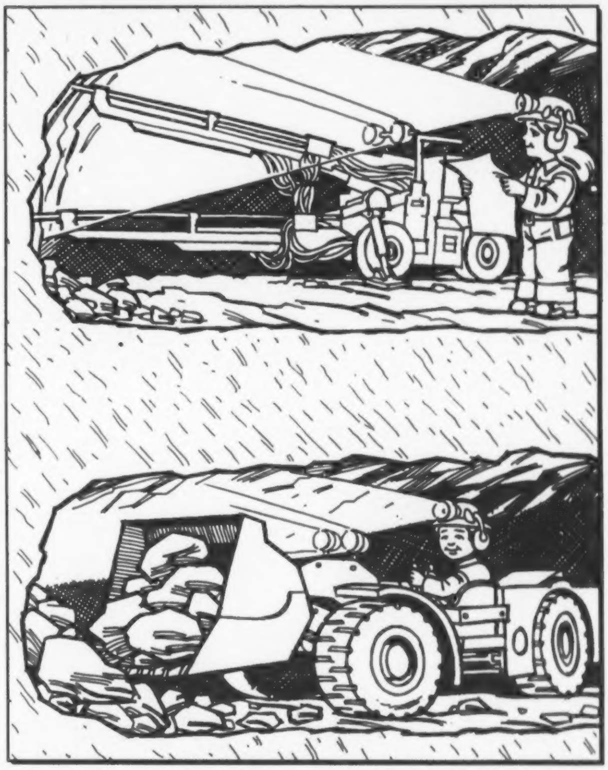



What is Mining?
A mine is … where we
Name three th… from a…
Why do we…

WHAT'S A MINE? COLOURING BOOK

Not only will your students learn about mining, they will have fun discussing why some words, such as color, are spelled differently in other English-speaking countries.





It Comes From a Mine and *Whats a Mine? Colouring Book* are both appropriate for grades 3 to 6 and can be adapted quite easily for grades 1 and 2. Single copies are available by **writing on school letterhead.**

ORDER FROM: **Placer Dome Inc.**
Corporate Communications
1055 Dunsmuir Street, Suite 1600
P.O. Box 49330 Bentall Postal Station
Vancouver, British Columbia
CANADA V7X 1P1

Note: Canadian Postage is higher than the U.S. — Letters cost 40¢; postcards 30¢
REMEMBER — As a courtesy to those offering free items, please **DO NOT abbreviate** your address, especially city, and print clearly.

The Mineral Information Institute (MII) also is pleased to bring to your attention other excellent resource materials.

REMEMBER — As a courtesy to those offering free items, please **DO NOT abbreviate** your address, especially city, and print clearly.

ANATOMY OF A MINE FROM PROSPECT TO PRODUCTION. A 69-page publication with 22 excellent illustrations.

ORDER FROM:
Publications Distribution
Intermountain Research Station
U.S. Forest Service
324 25th Street
Ogden, Utah 84401

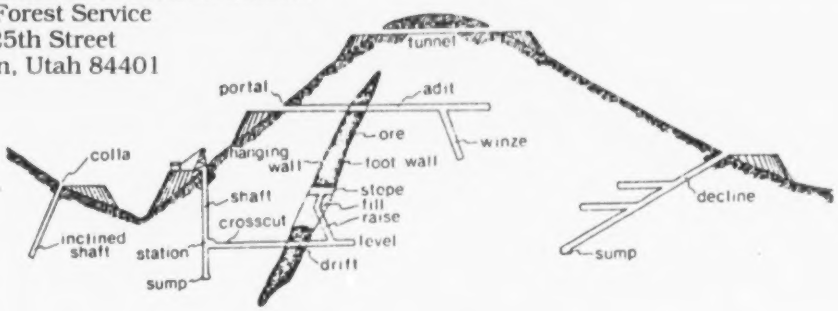
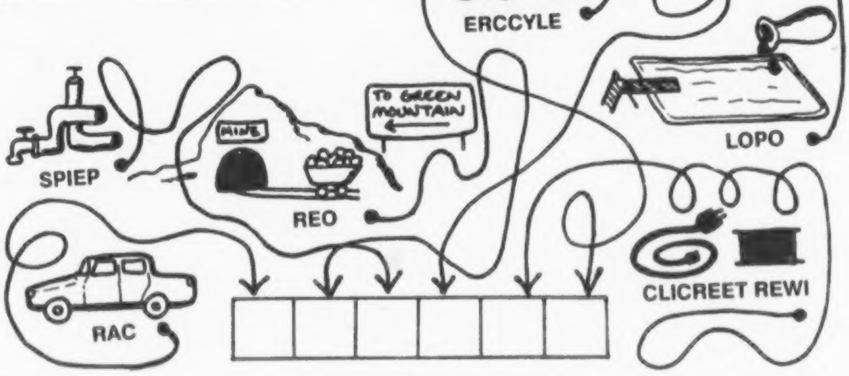

tunnel
portal
adit
colla
hanging wall
ore
foot wall
winze
shaft
stope
fill
raise
crosscut
level
inclined shaft
station
drift
sump
decline
sump

Figure 13.--Underground mining terms.

MIGHTY MINERALS. A 50-page teaching unit for grades 3 and 4 (easily adapted to grades 5 and 6) authored by Mary Ellen Gill, a certified elementary teacher in the state of Washington. Single copies are available free by writing on school letterhead. Requests not made on school letterhead should enclose a check for $3.00 made payable to the Northwest Mining Association.

ORDER FROM:
Northwest Mining Association
Attention: Mighty Minerals
414 Peyton Building
Spokane, Washington 99201


ERCCYLE
TO GREEN MOUNTAIN
MINE
LOPO
SPIEP
REO
CLICREET REWI
RAC

ORDER FORM
GEM EDUCATIONAL MATERIALS

Distributed by:

The Society for Mining, Metallurgy and Exploration, Inc.
8307 Shaffer Pkwy., Littleton Colorado 80127
Phone: (303) 973-9550 Fax: (303) 973-3845

Government Education & Mining

These materials are made available by the Society for Mining, Metallurgy and Exploration, Inc. (SME) through its **Government, Education and Mining (GEM) Program** to support its members in educating the general public about the importance of minerals to society.

FREE MATERIALS

Due to the high cost of printing, requests are limited to one copy; all materials may be photocopied.

DESCRIPTION	✓
SME MINERALS & MINING INFORMATION PACKET Miscellaneous printed materials for classroom use. All material may be photocopied.	
TEACHER TRAINING PACKET - ELEMENTARY Developed by the Nevada Mining Assn.; contains *classroom projects, games and other learning exercises* about minerals and mining.	
TEACHER TRAINING PACKET - HIGH SCHOOL Developed by the Nevada Mining Assn.; contains *classroom projects, games and other learning exercises* about minerals and mining.	
ARTICLE REPRINTS: ENVIRONMENTAL ISSUES A collection of articles on topics such as GLOBAL WARMING, ACID RAIN, and OZONE DEPLETION.	
BACK-COPIES OF GEM FACTS (last 12 issues) The *GEM Facts* column is a regular feature in SME's monthly journal, *Mining Engineering*. It highlights the accomplishments of SME members involved in educating society about the importance of minerals and mining. It also discusses public issues related to the minerals industry. An excellent reference for educational resources.	
GEM PROGRAM MANUAL The GEM Manual contains a wealth of information and suggestions for GEM activities and how **SME MEMBERS** can organize and develop a successful SME GEM committee in their area.	
VIDEO LIBRARY LIST This service is available to **SME MEMBERS**. **Non-members** can use the service through an SME member. Please call or write SME Headquarters for an SME contact person in your local area.	

VIDEOS

	QTY	PRICE	TOTAL
"OUT OF THE ROCK" (29 min) **Produced by the U.S. Bureau of Mines.** For Jr. High to Adult audience; Examines the importance of minerals and mining; provides examples of mineral use in everything from glass to makeup to toothpaste to wiring. Also, discusses recycling and environmental issues.	_ VHS _ PAL	$10.00 $10.00	$
"COMMON GROUND" (26 min) **Produced by Caterpillar.** For Elementary to Adult audience; stresses the importance of minerals and mining to our standard of living; covers history, environmental concerns, exploration, mine development, public perceptions and using public involvement as an educational tool. (The *Common Ground* package includes a Teacher's Guide, User's Guide, and "Modern Mining & You" informational booklet.) (Also, see "CLASSROOM WORKBOOKS" next page)	_ VHS _ PAL	$10.00 $10.00	$
"TIERRA de TODOS (LAND of ALL)" (*Spanish*; 26 min) **Produced by Caterpillar.** The story of modern mining in Latin America - tells of mining's products, advancements, and increased concern for the environment. Visits a Dominican nickel mine, a llama farm in Chile, and the copper mining region of the Atacama desert.	_ VHS	$10.00	$
"LET's DO MINERAL SCIENCE" (30 min) **Produced by U.S. Bureau of Mines.** Demonstrates six(6) "hands-on" classroom activities ("Chocolate Chip Cookie Mining," for example) to teach the mining process, the economics of mining, and what minerals various products are made from. Activity worksheets included with video.	_ VHS	$7.00	$

BEST COPY AVAILABLE

POSTERS

BULK ORDER DISCOUNT: 30 or more OF SAME POSTER are $1.80 each plus Shipping/Handling.

"ROCKS & MINERALS & HOW WE USE THEM" Illustrates the many uses of rocks and minerals.		$3.00	$
"ROCAS Y MINERALES a Nuestro Alrededor" *Spanish Version* of Rocks & Minerals & How We Use Them.		$3.00	$
"FROM THE MINE TO MY HOME" Exploration, mining, processing, consumption and recycling of minerals.		$3.00	$
"ELECTRIC GENERATION" Shows how electricity is generated and how it gets to our homes and businesses.		$3.00	$
"COAL" Describes formation, exploration, extraction, transportation and use of coal.		$3.00	$
"FROM MOUNTAINS TO METALS" Detailed information about exploration, mining, processing and the refining of minerals. Includes reclamation, transportation, manufacturing and uses of minerals.		$3.00	$
"SWITCHED ON MINING" Identifies minerals all around girl at computer.		$3.00	$
"MINING AT PLAY" Even skateboarders depend on minerals – for clothing, equipment, boards & boom boxes.		$3.00	$
"LOOK AROUND" Shows how everything in and around your house is made from something - and most things you see are made from minerals.		$3.00	$

CLASSROOM WORKBOOKS & TEACHING AIDS

"COMMON GROUND EDUCATIONAL PACKAGE" A Companion to the Common Ground video. Individual teaching packets for Grades 3-5, 6-8 & 9-12 PLUS a Poster "Modern Mining and You."		$2.00	$
"MIGHTY MINERALS" Teaching unit for the *4th Grade* classroom. Students will learn some of the basic characteristics/uses of each mineral presented.		$1.00	$
"MINED IT!" A fairy tale about metals and minerals that reveals their indispensable role in everyday life. 60 pages of story, illustrations, glossary, notes on minerals, and word puzzles.		$3.95	$
"OUT OF THE ROCK" (544-pages) A comprehensive mineral resource and mining education program for grades K-8. This program of integrated activities and information teaches how we locate, extract, process, manufacture, and recycle our earth's minerals.		$20.00	$
"DISCOVER MINING!" DOS Computer Disk with 3 Games: *School of Mines, Explore, and Bonanza Gold.* Teaches users about the economics of exploration and mining. (Please specify disk size required.)	3.5" 5.25"	$5.00 $5.00	$________ $__ _______
"COAL COUNTRY" (Set of 5 Computer Disks for **Macintosh** [*requires 11 megs hard drive; 5.5 megs RAM*] or **DOS** [*3.5" disks only; PC/Windows software requires 13 MB of hard drive Microsoft Windows 3.1 or later; 8 megs RAM*]) Learn about coal formation, deposit locations, mining techniques, and common uses of coal in everyday life. An interactive program using *animation, music and colorful graphics* to stimulate the viewer's interest.	MAC 3.5" DOS	$7.50 $7.50	$________ $________

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Developing Natural Resources on Public Lands
Minerals Showcase Series

This series of five videos was produced by federal and state government land use agencies in cooperation with private industries operating throughout the western United States.

The purpose of the series is to show the successes that exist between government and industry when developing natural resources, ensuring environmentally safe operations and still allowing access to the Earth's resources.

Showcasing Mineral Activities demonstrates the concept of mineral activities being conducted on National Forest System lands in harmony with other resources and values. Showcasing is a way to get minerals needed by society extracted from the Earth in an environmentally sensitive manner. It discusses the cooperation and partnerships involved in mining on these public lands. 15:00 Minutes

Phosphate and the Forest offers a comprehensive look at today's modern phosphate industry to produce this fertilizer critical to foods and other plants necessary to sustain life on Earth. It illustrates other needs for phosphate and the pure element phosphorus in today's modern lifestyle. It explores the economic and environmental impact of phosphate mining in southeast Idaho. It explains the cooperative industry/government partnership in natural resource management on public lands. 28:30 Minutes

Coal Mining in a Multiple Use Environment illustrates that coal extraction is an important use of our public lands and is part of the multiple-use land management concept. It explains how coal was formed, and demonstrates how it can be mined through industry/government cooperation in a manner that the forest visitor is unaware of it taking place. 19:00 Minutes

Hardrock Showcase— Humboldt National Forest shows how gold mining operations can be integrated with other uses of public land. It demonstrates that through careful planning, design and personal commitment, environmental impacts from minerals extraction can be reduced to an acceptable level. It explains special measures taken to protect a threatened species of cutthroat trout. 16:46 Minutes

Wasatch-Cache Petroleum Showcase illustrates that through the right level of cooperation and planning, the Forest Service, other regulatory agencies, and the petroleum industry, can develop the nation's energy resources while making every effort to preserve and enhance environmental values for wildlife habitat and watershed protection. 18:30 Minutes

Teachers and media specialists are encouraged to copy these videos and share them with other teachers and schools.

Send order and check for $3 each to:

Mineral Information Institute
475 17th Street, Suite 510
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Institute of Scrap Recycling Industries, Inc.

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Washington, DC 20005-3104
Phone: (202) 466-4050; Fax (202) 775-9109
Contact: Celeste Morgan

The national trade association of processors, brokers, and industrial consumers of scrap metals, paper, plastics, glass, rubber, and textiles. It represents the private recycling industry. *The Original Recyclers.*™

STUDENT & TEACHER RESOURCES

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The Scrap Map-An Environmental Publication for Grades K-6. A colorful 6" x 9" brochure that explains and illustrates recycling by following autos, beverage cans, and newspapers through the recycling process. Incorporates games, activities, and a poster. Individual copies free. Packages of 30 are $15.00. Packages of 50 are $25.00.

The Scrap Map Teacher's Kit. Use along with Scrap Map brochure. Includes suggestions for 10 days of lessons on recycling, bulletin board designs and materials, background literature for more in-depth discussion, plus a list of regional speaker contacts. $5.00 per kit.

Grades 7-College

Commodity Brochures.
Full-color brochures that explain how specific materials are recycled. Individual copies are free; request by title.

Recycling Scrap Iron and Steel
Recycling Nonferrous Scrap Metals
Recycling Paper
Recycling Plastics

Backgrounders on Scrap Recycling
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Recycling:: The Economic and Environmentally Intelligent Alternative to Landfilling and Incineration. 8-panel pamphlet.

The Original Recyclers: 4-color magazine format. Includes charts and tables, "scrap facts," information on energy savings and environmental benefits; traces the life cycle of a car.

Scrap: America's Ready Resource: 4-color magazine format. Comprehensive picture of the scrap recycling industry and its evolution in the United States.

GOVERNMENT AGENCIES TO CONTACT FOR FURTHER INFORMATION

United States Federal

Energy Department
Energy Information Administration
1000 Independence Avenue, S.W.
Washington, D.C. 20585
Phone: (202) 586-5000

Geological Survey
National Center Building
12201 Sunrise Valley Drive, MS 101
Reston, Virginia 22092
Phone: (703) 648-4000

Geological Survey
Western Region
345 Middlefield Road, MS 919
Menlo Park, California 94025-3591
Phone: (415) 329-4006

Geological Survey
GEO Center Building 20
Room C-2002, Mail Stop 914
P.O. Box 25046
Denver Federal Center
Denver, Colorado 80225-0046
Phone: (303) 236-1015

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Mineral Information Office -Reno
c/o Mackay School of Mines
Scrugham Engineering Mines Building
University of Nevada - Reno
Reno, Nevada 89557-0047
Phones: (702) 784-5590; -5552

Mineral Information Office -Spokane
U.S. Post Office Building, Room 133
West 904 Riverside Avenue
Spokane, Washington 99201
Phones: (509) 353-3113; -2649

Mineral Information Office -Tucson
Corbett Building
340 North 6th Avenue
Tucson, Arizona 85705
Phones: (602) 670-5508; -5544 or
(303)236-5704

Mines Bureau
810 7th Street, N.W.
Washington,D.C. 20241
Phone: (202) 501-9300
Ask for list of USBM field offices

Regional offices may be in/or near your community. In your phone book see: Dept. of Agriculture for *Forest Service* and *Soil Conservation Service*. Under the Interior Dept. you will find: *Bureau of Land Management, Bureau of Mines, Geological Survey. National Park Service, etc.*

Canadian Federal

Energy, Mines and Resources
580 Booth Street
Ottawa, Ontario K1A OE4
Phone (613) 995-0947

Geological Survey of Canada
601 Booth Street
Ottawa, Ontario K1A OE8 CANADA
Phone (613) 992-5910

Indian and Northern Affairs
Les Terrasses de la Chaudiere
10 Wellingington Street, North Tower
Hull, Quebec, CANADA
Mailing: Ottawa,, Ontario K1A 0H4
CANADA
Information, publications distribution
Phone (819) 997-0380

State / Province / Local Governments

For agencies dealing with natural resources check your telephone book.

OTHER CONTACTS

Resource people and operations are located in most communities. They can be a source of information, offer field trips, and provide classroom speakers. (As an example-- how is concrete made? Why are minerals assayed?) To find them look in the telephone *Yellow Pages* under:

Assayers
Associations
Concrete
Consultants- Energy; Mining
Electric Companies
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  Conservation Consultants
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GENERAL INTEREST PUBLICATIONS
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If you are interested in receiving a copy of the **Earth Science Resource Guide**, our quarterly newsletter **The ADIT**, announcement of our **Mineral Education Conference**, and wish to be on our mailing list, please fill out this form and mail to the address below:

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5. **Mining: Have You Thought About It?:** A full colored student booklet showing the various careers available in the Nevada mining industry. Available in limited quantities to teachers at no cost.

6. **History of Minerals in Nevada:** A special instructional unit for use in Jr. High Nevada History classes. Unit includes video and special historic maps. Available on loan.

7. **Mining in Nevada:** A student activity book for use in the elementary schools (K-3) Available in limited quantities to teachers at no cost.

8. **Major Mines of Nevada:** A directory of all mining operations in Nevada. Available at no cost.

Contacts:

Nevada Division of Minerals
400 W. King Street, Suite 106
Carson City, Nevada 89710

Phone: 702/687-5050

Nevada Mining Association
5250 South Virginia Street, Suite 220
Reno, Nevada 89502

Phone: 702/829-2121

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CONTACT your **State Geologist** for a list of publications, maps, and services available to classroom teachers and students.

Geologist: One engaged in geologic study or investigations; one versed in geology.

A geologist—

- **studies the physical nature, structure and history of the Earth's crust;**
- **conducts research into the formation and dissolution of rock layers;**
- **analyzes fossil and mineral content of layers and endeavors to fix historical sequence of development by relating characteristics to known geologic influences;**
- **studies dynamic processes that bring about changes in the Earth's crust- great internal pressure and heat; volcanic eruptions; earthquakes; and air, water, and glacial erosion;**
- **studies seismic, gravitational, electrical, thermal, and magnetic phenomena to determine structure and composition of Earth's surface;**
- **employs theoretical knowledge and research data to locate mineral, oil and gas deposits, and determines the probable area, slope, and accessibility of ore deposits;**
- **prepares reports, maps and diagrams of regions explored.**

Geologists love their profession because of the challenge of solving complex scientific problems. They especially enjoy the out-of-doors field work. Geologists also gain great satisfaction when their knowledge benefits humanity by finding resources, recognizing geologic hazards, or providing data for land-use decisions.

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Dr. Ernest A. Mancini
State Geologist
Geological Survey of Alabama
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(205) 349-2852, FAX 349-2852

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Mr. Thomas E. Smith
Director and State Geologist
Div. of Geology and Geophysical Surveys
794 University Avenue, Suite 200
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(907) 474-7147, FAX 479-4779

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State Geologist
Arizona Geological Survey
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Tucson, Arizona 85719-4816
(602) 882-4795, FAX 628-5106

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State Geologist and Director
Arkansas Geological Commission
3815 West Roosevelt Road
Little Rock, Arkansas 72204
(501) 324-9165; FAX 663-7360

California
Mr. James F. Davis
State Geologist
Department of Conservation
Division of Mines and Geology
801 K Street, MS12-30
Sacramento, California 95814-3531
(916) 445-1923; FAX 445-5718

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Director and State Geologist
Colorado Geological Survey
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(303) 866-2611; FAX 866-2461

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Geological & Natural History Survey
Natural Resources Center
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State Geologist and Director
Delaware Geological Survey
University of Delaware
Newark, Delaware 19716
(302) 831-2833; FAX 831-3579

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Dr. Walter Schmidt
State Geologist
Florida Geological Survey
903 West Tennessee Street
Tallahassee, Florida 32304-7700
(904) 488-4191; FAX 488-8086

Georgia
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State Geologist
Georgia Geological Survey
Room 400
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Mr. Manabu Tagomori
Hawaii Geological Survey
Div. of Water and Land Development
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Honolulu, Hawaii 96809
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Idaho Geological Survey
University of Idaho
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(208) 885-7991; FAX 885-5826

Illinois
Dr. Morris W. Leighton, Chief
Illinois State Geological Survey
121 Natural Resources Building
615 East Peabody Drive
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(217) 333-4747; FAX 244-7004

Indiana
Dr. Norman C. Hester
State Geologist and Director
Indiana Geological Survey
611 North Walnut Grove
Bloomington, Indiana 47405
(812) 855-9350; FAX 855-2862

Iowa
Mr. Donald L. Koch
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Geological Survey Bureau
123 North Capitol Street
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(319) 335-1575; FAX 335-2754

Kansas
Dr. Lee C. Gerhard
Director and State Geologist
Kansas Geological Survey
1930 Constant Avenue, West Campus
University of Kansas
Lawrence, Kansas 66047
(913) 864-3965; FAX 864-5317

Kentucky
Dr. Donald C. Haney
State Geologist and Director
Kentucky Geological Survey
228 Mining/Mineral Resources Bldg
University of Kentucky
Lexington, Kentucky 40506-0107
(606) 257-5500; FAX 257-1147

Louisiana
Dr. Charles G. Groat
Director and State Geologist
Louisiana Geological Survey
Natural Resources Department
Box G, University Station
Baton Rouge, Louisiana 70893
(504) 388-5320; FAX 388-5328

Maine
Mr. Walter A. Anderson
Director and State Geologist
Maine Geological Survey
Department of Conservation
State House, Station 22
Augusta, Maine 04333
(207) 289-2801; FAX 289-2353

Maryland
Mr. Emery T. Cleaves, Director
Maryland Geological Survey
2300 St. Paul Street
Baltimore, Maryland 21218-5210
(301) 554-5500; FAX 554-5502

Massachusetts
Mr. Joseph A. Sinnott
State Geologist
Massachusetts Geological Survey
100 Cambridge Street, 20th Floor
Boston, Massachusetts 02202
(617) 727-9800; FAX 727-2754

Michigan
Mr. R. Thomas Segall
State Geologist
Michigan Geological Survey
Dept. of Natural Resources
P.O. Box 30028
Lansing, Michigan 48909
(517) 334-6923; FAX 334-6038

Minnesota
Dr. David L. Southwick, Director
Minnesota Geological Survey
2642 University Avenue
St. Paul, Minnesota 55114-1057
(612) 627-4780; FAX 627-4778

Mississippi
Mr. S. Cragin Knox
Director and State Geologist
Mississippi Office of Geology
Department of Environmental Quality
P.O. Box 20307
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(601) 961-5500; FAX 961-5521

Missouri
Dr. James H. Williams
Director and State Geologist
Dept. Natural Resources
Geology & Land Survey Division
111 Fairgrounds Rd., P.O. Box 250
Rolla, Missouri 65401
(314) 368-2100; FAX 368-2111

Montana
Dr. John C. Steinmetz
Director and State Geologist
Montana Bureau of Mines & Geology
Montana College of Mineral Science
and Technology
Main Hall
Butte, Montana 59701
(406) 496-4180; FAX 496-4133

Nebraska
Dr. Perry B. Wigley, Director
Nebraska Geological Survey
Conservation & Survey Division
The University of Nebraska
901 N. 17th St., 113 Nebraska Hall
Lincoln, Nebraska 68588-0517
(402) 472-3471; FAX 472-2410

Nevada
Dr. Jonathan G. Price
Director and State Geologist
Nevada Bureau of Mines
and Geology
Reno, Nevada 89557-0088
(702) 784-6691; FAX 784-1709

New Hampshire
Dr. Eugene L. Boudette
State Geologist
University of New Hampshire
Geology Unit-Earth Science Dept.
117 James Hall
Durham, New Hampshire 03824-3589
(603) 435-2975; FAX 862-2030

New Jersey
Mr. Haig F. Kasabach
State Geologist
New Jersey Geological Survey
Division of Science & Research
29 Arctic Parkway; P.O. Box CN-029
Trenton, New Jersey 08625
(609) 292-1185; FAX 633-1004

New Mexico
Dr. Charles E. Chapin
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New Mexico Bureau of Mines/Mineral
Resources
Campus Station
Socorro, New Mexico 87801
(505) 835-5420; FAX 835-6333

New York
Dr. Robert H. Fakundiny
State Geologist and Chief
New York Geological Survey
3136 Cultural Education Center
Empire State Plaza
Albany, New York 12230
(518) 474-5816; FAX 473-8496

North Carolina
Mr. Charles Gardner
Director and State Geologist
North Carolina Geological Survey
Division of Land Resources
P.O. Box 27687
Raleigh, North Carolina 27611-7687
(919) 733-3833; FAX 733-4407

North Dakota
Mr. John Q. Bluemle
State Geologist
North Dakota Geological Survey
600 East Boulevard
Bismarck, North Dakota 58505-0840
(701) 224-4109; FAX 224-3682

Ohio
Mr. Thomas Berg
Division Chief and State Geologist
Ohio Geological Survey
Dept. of Natural Resources
4383 Fountain Square Drive, Bldg. B
Columbus, Ohio 43224-1362
(614) 265-6576; FAX 447-1918

Oklahoma
Dr. Charles J. Mankin, Director
Oklahoma Geological Survey
100 East Boyd, Room N-131
Norman, Oklahoma 73019-0628
(405) 325-3031; FAX 325-3180

Oregon
Dr. Donald A. Hull
Director and State Geologist
Dept. Geology and Mineral Industries
Suite 965
800 NE Oregon St. #28
Portland, Oregon 97232
(503) 731-4600; FAX 731-4066

Pennsylvania
Dr. Donald M. Hoskins
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Bur. Topographic & Geologic Survey
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P.O. Box 2357
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(717) 787-2169; FAX 773-7267

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Dr. J. Allan Cain
State Geologist
Rhode Island Geological Survey
University of Rhode Island
315 Green Hall
Kingston, Rhode Island 02881
(401) 792-2265; FAX 792-2190

South Carolina
Mr. Norman K. Olson
State Geologist
South Carolina Geological Survey
5 Geology Road
Columbia, South Carolina 29210-9998
(803) 737-9440; FAX 737-9487

South Dakota
C.M. Christensen
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South Dakota Geological Survey
USD Science Center
Vermillion, South Dakota 57069-2390
(605) 677-5227; FAX 677-5895

Tennessee
Dr. Edward T. Luther
State Geologist
Tennessee Division of Geology
Customs House, 701 Broadway
Suite B-30
Nashville, Tennessee 37243-0445
(615) 742-6689; FAX 742-6594

Texas
Dr. William L. Fisher
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Bureau of Economic Geology
Univ. of Texas at Austin
University Station, Box X
Austin, Texas 78713-7508
(512) 471-7721; FAX 471-0140

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Dr. M. Lee Allison
Director and State Geologist
Utah Geological & Mineral Survey
2363 South Foothill Drive
Salt Lake City, Utah 84109-1491
(801) 467-7970; FAX 467-4070

Vermont
Dr. Diane Contrad
State Geologist
Vermont Geological Survey
103 South Main Street
Center Building
Waterbury, Vermont 05671-3016
(802) 244-5164; FAX 244-1102

Virginia
Dr. Stanley S. Johnson
State Geologist
Virginia Mineral Resources Division
Dept. of Mines, Minerals & Energy
P.O. Box 3667
Charlottesville, Virginia 22903
(804) 293-5121; FAX 293-2239

Washington
Mr. Raymond Lasmanis
State Geologist
Washington Geological Survey
P.O. Box 47007
Olympia, Washington 98504-7007
206) 459-6372; FAX 459-6380

West Virginia
Mr. Larry D. Woodfork
Director & State Geologist
West Virginia Geological and Economic
Survey
Mount Chateau Research Center
P.O. Box 879
Morgantown, WV 26507-0879
(304) 594-2331; FAX 594-2575

Wisconsin
Dr. James Robertson
State Geologist and Director
Wisconsin Geological
and Natural History Survey
3817 Mineral Point Road
Madison, Wisconsin 53705-5100
(608) 263-1705; FAX 262-8086

Wyoming
Mr. Gary B. Glass
State Geologist
Wyoming State Geological Survey
P.O. Box 3008, University Station
Laramie, Wyoming 82071-3008
(307) 766-2286; FAX 766-2605

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Servicio Geologico de Puerto Rico
Geology Division
Dept. de Recursos Naturale
Munoz Rivera Avenue, Stop 3
San Juan, Puerto Rico 00906
(809) 724-8774, ext. 221, 207

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Pan for Gold in Your Classroom

What to Expect: Noise; splashing; lost gold *(have an extra refill: all refills contain about 12 flakes of gold)*; and one of the BEST activities your class has ever had.

Caution: If your students will be sharing a kit or a refill, while there will be enough gold to share, there is only one vial in each bag of ore. You can get extra vials from your Pharmacy, most hardware stores, or check the Yellow Pages under "Bottles".

For Classroom Panning: You'll need sinks or wash tubs. *Sinks* are easier if your entire class is panning. Two kids can share a pan (although it slows down the activity) and can share one sink. Make sure to plug the drain with a strainer and piece of cloth to prevent the dirt from clogging the drain. Then fill the sink about 3/4 full of water. *Wash tubs* are cumbersome but easier for students to use because they are larger and the extra space helps. Unfortunately they are harder to lift (when filled with water) and to clean up after. A wading pool will work great but it is even bigger and heavier and more prone to get holes and leak water. In all these methods, remember there will be lots of splashing and a mess to clean up. If possible do it outside. Better yet, try to find a small stream or pond to help the activity, then the clean up is a breeze.

For beginning panners we strongly recommend getting the **Teacher's Special** which includes a Kit and Refill. This way you can practice your technique in the privacy of your room so that you can look like an expert in front of your kids when you use the Refill (with new gold) for the demonstration.

Read The Instruction Book First. Gold Panning is really quite easy.

If you will be using the kit(s) as an activity rather than just a demonstration, it's best that each student have his own pan. Maybe you can find a supplier in your area who will provide them cheaper (or at no cost). Check the Yellow Pages under "Mining Suppliers".

If you have a problem, call us or write: **The Mineral Information Institute, 475 17th Street, Suite 510, Denver, Colorado 80202, 303/297-3226.**

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GOLD ORE for hand panning
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Display Vial for GOLD
"Secrets of Gold Panning" book

Gold Pan

12" Thermoplastic pan. It's better than a steel pan because it doesn't rust, and it's designed to have a deep center edge and three "cheater" ridges along the edge to keep your gold from washing out. The advantages of a metal pan are: you can use it as a shovel to dig and at the end of the day you can throw it on your campfire to cook your beans in it.

Refill #1

Contains Gold Ore for hand panning, instruction book and vial for gold flakes.

Refill #2

Contains Gold Ore for hand panning, instruction book and vial for gold, *PLUS* Hand Lens, Magnet, Eyedropper, *AND* the "Secrets of Gold Panning Book" which contains a sample flake of Real Gold.

Watch Out!!

MINERAL INFORMATION INSTITUTE

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Pan for GOLD

in your classroom

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